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Heat Transfer From Cylinders in Subsonic Slip Flows

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CONTENTS

List of Figures iv

List of Tables vi

Abstract vii

Nomenclature viii

Introduction 1

Theoretical Considerations 2

Facility 9

Instrumentation 10

Results 12
- Power vs. Velocity 13
- $Nu_{t,corr}$ vs. Re_t 14
- $Nu_{t,corr}$ vs. Kn 15
- $Nu_{t,corr}$ vs. M 16
- Comparison of $Nu_{t,corr}$ for different wire diameters 16
- Hot-wire Sensitivities 16
  - Velocity Sensitivity 19
  - Density Sensitivities 20
  - Velocity sensitivity versus Density sensitivity 20
  - Temperature Sensitivity 22
  - Comparison of Sensitivities 22

Constant Temperature Hot Wire Anemometry 24

Conclusion 26

References 28

Appendix-A 29

Appendix-B 39

Figures 53

List of Figures

Figure 1. NASA Langley Low Turbulence Pressure Tunnel (LTPT) 53
Figure 2. Data acquisition system block diagram 54
Figure 3. Geometry of probes 54
Figure 4. Power vs. Velocity for parallel wire probe 55
Figure 5. Power vs. Velocity for Y-wire probe 61
Figure 6. Power vs. Velocity for single wire probe 66
Figure 7. Nusselt number vs. Reynolds number for parallel wire probe 68
Figure 8. Nusselt number vs. Reynolds number for Y-wire probe 73
Figure 9. Nusselt number vs. Reynolds number for single wire probe 78
Figure 10. Nusselt number vs. Knudsen number for parallel wire probe 80
Figure 11. Nusselt number vs. Knudsen number for Y-wire probe 85
Figure 12. Nusselt number vs. Knudsen number for single wire probe 90
Figure 13. Nusselt number vs. Mach number for parallel wire probe 92
Figure 14. Nusselt number vs. Mach number for Y-wire probe 97
Figure 15. Nusselt number vs. Mach number for single wire probe 102
Figure 16. Nusselt number vs. Kundsen number (for Mach number of 0.05 & 0.20) for parallel wire probe 104
Figure 17. Nusselt number vs. Kundsen number (for Mach number of 0.05 & 0.20) for Y-wire probe 106
Figure 18. Velocity vs. S_u computed as $E = f(u,\rho,T_o)$ for parallel wire probe 108
Figure 19. Velocity vs. S_u computed as $Nu_t = f(M,Kn,\tau)$ for parallel wire probe 113
Figure 20. Velocity vs. S_u computed as $E = f(u,\rho,T_o)$ for Y-wire probe 118
Figure 21. Velocity vs. S_u computed as $Nu_t = f(M,Kn,\tau)$ for Y-wire probe 123
Figure 22. Velocity vs. S_u computed as $E = f(u,\rho,T_o)$ for single wire probe 128
Figure 23. Velocity vs. S_u computed as $Nu_t = f(M,Kn,\tau)$ for single wire probe 130
Figure 24. Velocity vs. S_ρ computed as $E = f(u,\rho,T_o)$ for parallel wire probe 132
Figure 25. Velocity vs. S_ρ computed as $Nu_t = f(M,Kn,\tau)$ for parallel wire probe 137
Figure 26. Velocity vs. S_ρ computed as $E = f(u,\rho,T_o)$ for Y-wire probe 142
Figure 27. Velocity vs. S_ρ computed as $Nu_t = f(M,Kn,\tau)$ for Y-wire probe 147
Figure 28. Velocity vs. S_ρ computed as $E = f(u,\rho,T_o)$ for single wire probe 152
Figure 29. Velocity vs. S_ρ computed as $Nu_t = f(M,Kn,\tau)$ for single wire probe 154
Figure 30. S_ρ vs. S_u computed as $E = f(u,\rho,T_o)$ for parallel wire probe 156

Figure 31. S_ρ vs. S_u computed as $Nu_t = f(M,Kn,\tau)$ for parallel wire probe 161
Figure 32. S_ρ vs. S_u computed as $E = f(u,\rho,T_o)$ for Y-wire probe 166
Figure 33. S_ρ vs. S_u computed as $Nu_t = f(M,Kn,\tau)$ for Y-wire probe 171
Figure 34. S_ρ vs. S_u computed as $E = f(u,\rho,T_o)$ for single wire probe 176
Figure 35. S_ρ vs. S_u computed as $Nu_t = f(M,Kn,\tau)$ for single wire probe 178
Figure 36. Velocity vs. S_{T_o} computed as $E = f(u,\rho,T_o)$ for parallel wire probe 180
Figure 37. Velocity vs. S_{T_o} computed as $Nu_t = f(M,Kn,\tau)$ for parallel wire probe 185
Figure 38. Velocity vs. S_{T_o} computed as $E = f(u,\rho,T_o)$ for Y-wire probe 190
Figure 39. Velocity vs. S_{T_o} computed as $Nu_t = f(M,Kn,\tau)$ for Y-wire probe 195
Figure 40. Velocity vs. S_{T_o} computed as $E = f(u,\rho,T_o)$ for single wire probe 200
Figure 41. Velocity vs. S_{T_o} computed as $Nu_t = f(M,Kn,\tau)$ for single wire probe 202
Figure 42. Comparison of velocity sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for parallel wire probe 204
Figure 43. Comparison of velocity sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for Y-wire probe 209
Figure 44. Comparison of velocity sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for single wire probe 214
Figure 45. Comparison of density sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for parallel wire probe 216
Figure 46. Comparison of density sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for Y-wire probe 221
Figure 47. Comparison of density sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for single wire probe 226
Figure 48. Comparison of temperature sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for parallel wire probe 228
Figure 49. Comparison of temperature sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for Y-wire probe 233
Figure 50. Comparison of temperature sensitivity computed using $E = f(u,\rho,T_o)$ vs. $Nu_t = f(M,Kn,\tau)$ for single wire probe 238

List of Tables

Table II.1 Raw data along with other quantities of interest for Y-wire probe 40

Table II.2 Raw data along with other quantities of interest for parallel wire probe 43

Table II.3 Raw data along with other quantities of interest for single wire probe 46

Table II.4 Raw data along with sensitivities computed as $E = f(u, \rho, T_o)$ for Y-wire probe 47

Table II.5 Raw data along with sensitivities computed as $E = f(u, \rho, T_o)$ for parallel wire probe 48

Table II.6 Raw data along with sensitivities computed as $E = f(u, \rho, T_o)$ for single wire probe 49

Table II.7 Raw data along with sensitivities computed as $Nu_t = f(M, Kn, \tau)$ for Y-wire probe 50

Table II.8 Raw data along with sensitivities computed as $Nu_t = f(M, Kn, \tau)$ for parallel wire probe 51

Table II.9 Raw data along with sensitivities computed as $Nu_t = f(M, Kn, \tau)$ for single wire probe 52

Abstract

The heat transfer from heated wires was measured using a constant temperature anemometer over a Mach number range from 0.05 to 0.4 and pressures from 0.5 to 8.0 atmosphere. The total temperature ranged from 80°F to 120°F and the wire diameters were 0.00015, 0.00032 and 0.00050 inch. The heat transfer data are presented in the form of corrected Nusselt number. Based on the criteria suggested by Baldwin (1958), much of the data were obtained in the slip flow regime. Therefore, the data are compared with his data having comparable flow conditions.

The possible application of the heat transfer data to hot wire anemometry is discussed. To this end, the sensitivity of the wires to velocity, density and total temperature is computed and compared using two different types of correlations.

Nomenclature

a^*	Equation 30
a_w	Equation 30
A_w'	Overheat parameter, Equation A-(29)
B^*	Equation 27
B_1	Equation 27
B_2	Equation 27
c_p	Specific heat at constant pressure
d_s	Diameter of wire supports
d_w	Wire diameter
e	Equation 25
e'	Fluctuating voltage
E	Mean voltage across wire
E'	Finite circuit parameter
E_b	Voltage across anemometer bridge
E_w	Voltage across hot-wire
G	Equation 23
h	Heat transfer coefficient
I_w	Current through hot-wire
$K = \frac{\partial \log R_w}{\partial \log T_w}$	Equation A-(20)
Kn	Knudsen number
k_s	Thermal conductivity of support material
$k_{t,s}$	Thermal conductivity of air at supports at T_o
k_t	Thermal conductivity of air at T_o
k_w	Thermal conductivity of wire
ℓ	Wire length

m	Mass
m'	Fluctuating mass
$m_t = \frac{\partial \log\mu_t}{\partial \log T_o}$	Equation A-(54)
M	Mach number
n	Equation 27
$n_t = \frac{\partial \log k_t}{\partial \log T_o}$	Equation A-(54)
Nu_t	Nusselt number
$Nu_{t,s}$	Nusselt number for supports
$Nu_{t,corr}$	Nusselt number corrected for heat loss to supports
P_o	Total pressure
P_w	Power to hot-wire
Pr	Prandtl number
Q_w	Heat transfer rate
r_w	Radius of wire
R_{adw}	Equation 31
R_ℓ	Lead resistance
R_t	Top resistance of anemometer
R_w	Resistance of wire
R_x	Extraneous lead resistance in parallel wire probe
Re	Reynolds number based on T_∞
Re_t	Reynolds number based on viscosity evaluated at T_o and wire diameter
$Re_{t,s}$	Reynolds number based on viscosity evaluated at T_o and diameter of supports
S	Equation 32

S_m	Mass sensitivity
S_u	Velocity sensitivity
S_ρ	Density sensitivity
S_{T_o}	Total temperature sensitivity
t^*	Equation 22
T_{adw}	Recovery temperature of wire
T_o	Total temperature
T_o'	Fluctuating total temperature
T_w	Wire temperature
T_∞	Free stream total temperature
u	Velocity
u'	Fluctuating velocity
Y	Equation 24
Z	Equation 21

α_1	Resistance temperature coefficient for wire
α	Mach number function, $\left[1 + \frac{\gamma-1}{2} M^2\right]^{-1}$
λ	Mean free path
$\eta = \frac{T_{adw}}{T_o}$	Recovery temperature ratio
μ	Viscosity evaluated at T_∞
μ_t	Viscosity evaluated at T_o
ρ	Density
ρ'	Fluctuating density
$\gamma = \frac{C_p}{C_v}$	Ratio of specific heats
$\theta = \frac{T_w}{T_o}$	Temperature parameter
$\tau = \frac{T_w - T_{adw}}{T_o}$	Temperature parameter
τ_{wr}	Temperature loading parameter, $\frac{T_w - T_{adw}}{T_{adw}}$
$\epsilon = -\frac{\partial \log I_w}{\partial \log R_w}$	Equation A-(21)

Introduction

The heat transfer from heated wires in fluid flows has been investigated for several years for various reasons. One of the main reasons in fluid mechanics is the application of the results to hot wire anemometry. The early work in this field was performed by Boussinesq (1905)[1] and King (1914)[2]. Even though King's "law" was derived over 75 years ago, it is still being used, in various forms, to predict the heat transfer from heated wires in subsonic flows. From King's law it can be shown that the heat transfer parameter, Nusselt number, is a function of only Reynolds and Prandtl numbers.

In the 1950's, however, data were obtained in subsonic flows which indicated that King's law did not apply[3,4]. That is, the Nusselt number was also shown to be a function of Mach number for Mach numbers as low as 0.1. The reason for this disagreement was determined by Spangenberg[5] to be due to a gas rarefaction effect or specifically to a slip flow effect rather than a Mach number or compressibility effect.

The present investigation describes heat transfer data taken over a range of Reynolds and Mach numbers, total temperatures, and wire diameters. The results include data ranging from the slip flow to the continuum flow regime. The present data are compared with Baldwin's data taken in the same flow regimes. Finally, the results are discussed in terms of their application to hot wire anemometry.

Theoretical Considerations

King's law[2], in its original form but in terms of conventional symbols, can be written as:

$$Q_w = \ell(k_t + 2\sqrt{\pi k_t c_p \rho r_w u})(T_w - T_{adw}) \tag{1}$$

The heat transfer from a heated wire is usually given as:

$$Q_w = \pi d_w \ell h(T_w - T_{adw}) \tag{2}$$

Equation (2) can be expressed in terms of Nusselt number and the recovery temperature ratio as:

$$Q_w = \pi \ell k_t (T_w - \eta T_o) Nu_t \tag{3}$$

Using equations (1) and (3), King's law becomes:

$$Nu_t = \frac{1}{\pi} + \sqrt{\frac{2}{\pi}}\sqrt{PrRe_t} \tag{4}$$

Therefore, for King's law (M = 0), the Nusselt number is a function of Reynolds and Prandtl numbers.

In the 1950's, data were obtained at Mach numbers from 0.1 to 0.5 indicating that $Nu_t = f(Re_t, M)$ even at low Mach numbers[3,4]. These results indicated a Mach number or compressibility effect at M=0.1! However, Spangenberg[5] conducted additional tests and found that $Nu_t = f(Re_t, M, Kn)$,

and the apparent Mach number effect was really a slip flow or Knudsen number effect.

The Knudsen number is defined as:

$$Kn = \frac{\lambda}{d_w} \tag{5}$$

Using the results from kinetic theory[6], the Knudsen number can be expressed as follows:

$$Kn = \frac{1}{0.499} \sqrt{\frac{\gamma\pi}{2}} \frac{M}{Re} \tag{6}$$

If the viscosity is defined in terms of total temperature the above equation becomes:

$$Kn = \frac{1}{0.499} \sqrt{\frac{\gamma\pi}{2}} \frac{M}{Re_t} \frac{\mu}{\mu_t} \tag{7}$$

Since the Knudsen number is related to the Reynolds and Mach numbers, only two of the three quantities in the relationship for the Nusselt number are required. The functional relationship[7,8,9] for the Nusselt number is usually expressed as:

$$Nu_t = f(Re_t, M) \tag{8}$$

or

$$Nu_t = f(Kn, M) \tag{9}$$

Experimental results obtained by King and others indicated that Nusselt number is also a function of a temperature parameter. Using this result, equations (8) and (9) have been expressed as[7,8,9]:

$$Nu_t = f(Re_t, M, \theta) \tag{10}$$

or

$$Nu_t = f(Kn, M, \tau) \tag{11}$$

The recovery temperature ratio has been found to be a function of the following parameters[4]:

$$\eta = f(M, Re_t) \tag{12}$$

or

$$\eta = f(M, Kn) \tag{13}$$

For steady state heat transfer, the power supplied to the heated wire equals the heat transfer from the wire. Therefore, equation (3) becomes:

$$P_w = E_w I_w = \pi \ell k_t (T_w - \eta T_o) Nu_t \tag{14}$$

The voltage across the bridge of the DISA anemometer is[10]:

$$E_b = I_w (R_t + R_\ell + R_w) \tag{15}$$

From which the current to the wire is:

$$I_w = \frac{E_b}{(R_t + R_\ell + R_w)} \tag{16}$$

The voltage across the wire is:

$$E_w = I_w R_w \tag{17}$$

Substituting equation (16) into (17) gives:

$$E_w = \frac{E_b R_w}{(R_t + R_\ell + R_w)} \tag{18}$$

and the electrical power to the wire becomes:

$$P_w = \frac{E_b^2 R_w}{(R_t + R_\ell + R_w)^2} \tag{19}$$

Now the Nusselt number can be obtained from the following:

$$Nu_t = \frac{E_b^2 R_w}{\pi \ell k_t (T_w - \eta T_o)(R_t + R_\ell + R_w)^2} \tag{20}$$

This Nusselt number includes the effect of the heat loss to the supports. The Nusselt number can be corrected for end loss theoretically by taking into account the heat loss from the wire to its supports. For the present results, the equations given by Baldwin[8] will be used to make the end loss corrections. For convenience the equations given by Baldwin will be repeated here.

The corrected Nusselt number is given by:

$$Nu_{t,corr} = Nu_t(1 - t^*)\left(\frac{t^*}{1-t^*} + Z^2\right) \tag{21}$$

where

$$t^* = \frac{T_w - T_{adw}}{(1/\alpha_1 - 32) + T_w} \tag{22}$$

To solve equation (21), the following substitution are made:

$$G = B^*(1 - t^*) \tag{23}$$

$$e = Y\sqrt{(1 - t^*)} \tag{24}$$

Equation (21) can now be expressed as the following:

$$GZ + e = \frac{1}{Z - Z^3} \tag{25}$$

Equation (28) is the final equation given by Baldwin. The equation can be expanded to give:

$$GZ^4 + eZ^3 - GZ^2 - eZ + 1 = 0 \tag{26}$$

$$B^* = \frac{\ell\ k_t\ Nu_t}{(B_1 + B_2/Re^n_{t,s})^{0.5}(k_s k_{t,s})^{0.5} d_s} \tag{27}$$

$$Y = \sqrt{\left(\frac{k_t}{k_w}\right)} \quad \frac{\ell}{d_w} \sqrt{Nu_t} \tag{28}$$

The heat transfer to the supports was taken to be[11]:

$$Nu_{t,s} = B_1 + B_2 Re_{t,s}^n \tag{29}$$

The following values for B_1, B_2, and n are recommended in reference 9:

($Re_{t,s}$ Range)	n	B_1	B_2
0.1 - 1000	0.52	0.32	0.43
1000 - 50000	0.60	0.0	0.24

There are two real, positive roots between 0.0 and 1.0 and two real, negative or imaginary roots to equation (26). The smaller real, positive root and two real, negative or imaginary roots result in unreasonable values for the correction factor. Therefore, the root applicable for reasonably designed probes occurs between 0.5 and 1.0. For the present tests the values of Z ranged from 0.75 to 0.92.

Further checks on the end correction were made using the results given by Kovasznay[12]. These equations are as follows:

$$\frac{Nu_{t,corr}}{Nu_t} = \frac{\frac{a_w}{a^*} + a_w}{1 + a_w} \tag{30}$$

where

$$a_w = \frac{R_w - R_{adw}}{R_{adw}} \qquad (31)$$

$$\frac{a_w}{a^*} = 1.0 - S\sqrt{\frac{a_w}{a^*}} \tanh \frac{1}{S} \sqrt{\frac{a^*}{a_w}} \qquad (32)$$

$$S = \frac{d_w}{\ell} \sqrt{\frac{k_w}{k_t}} \sqrt{\frac{1 + a_w}{Nu_t}} \qquad (33)$$

In the present study Baldwin's method of end loss correction was utilized. However, in a very few cases where an unreasonable correction occurred and for wires having small $\frac{\ell}{d_w}$'s, Kovasznay's method was applied.

Facility

The present investigation was conducted in the Langley Research Center Low Turbulence Pressure Tunnel. A sketch of the tunnel is shown in figure 1. The tunnel is a closed circuit, fan driven facility equipped with a heat exchanger, a system of 9 screens in the settling chamber, and a nozzle with a contraction ratio of 17.6 to 1. The test section is 3 feet wide and 7.5 feet high and the probes were mounted in the center of the test section. A more detailed description of the facility can be found in Ref. 13. The tunnel can be operated over the following conditions:

$$3 < P_o\text{, psia} < 150$$

$$0.025 < M < 0.45$$

$$60 < T_o\text{, F} < 130$$

For the present test, data were limited to the following wind tunnel conditions:

$$7.5 < P_o\text{, psia} < 120$$

$$0.05 < M < 0.35$$

$$80 < T_o\text{, F} < 120$$

Instrumentation

The hot wire probes used had wire diameters of 0.00015, 0.00032, and 0.00050 inch. The ℓ/d of the wires ranged from about 60 to 200. Because of the high dynamic pressure in the LTPT, the wires were installed on their supports with some slack to prevent strain gaging and excessive stress. The probes were operated with a DIS55M anemometer system. The heat transfer equation (20) contains a constant term R_t and a variable term R_ℓ. The quantity R_t is part of the bridge circuit in the anemometer and has a resistance of 50 ohms. The term R_ℓ is the resistance of the lead from the anemometer to the heated wire. Since the present test was conducted over a range of total temperatures, the magnitude of R_ℓ could change with test conditions. Therefore, R_ℓ was measured using a dummy lead which had its resistance matched to those of the probe. The dummy lead was routed from the anemometer to the test section along with those of the probe. The dummy lead had an electrical short at the end within the tunnel. The resistance of the dummy lead was measured using a HP 3455A digital voltmeter.

Mean measurements of the voltage across the bridge of the anemometer were made using a NEFF 620-400 A/D converter which was controlled by a HP 9000 computer. The wind tunnel conditions were obtained from the data acquisition system for the tunnel and were sent to the HP 9000 computer for storage and printout. A sketch of the data acquisition system is shown in figure 2.

Three types of probes were used during the present investigation. One type of probe had only a single wire mounted on the probe. Two of the other probes had three wires installed; on one of these probes, the three wires were mounted parallel to each other and on the other probe, the three wires were mounted in a **"Y"** configuration. The latter design was used to reduce possible flow and thermal interferences between the wires for the multi-wire probes. For all these probes the wires were mounted **"normal"** to the flow. A sketch of these three probes are presented in figure 3.

Results

For the present investigation, three probes each having a different configuration, were used to obtain the heat transfer to small diameter wires. The raw data collected along with other quantities of interest are presented in Appendix-B. As noted in the theoretical consideration section, the heat transfer data from the heated wires can be expressed as Nusselt numbers where the Nusselt numbers are functions of either Re_t, M, θ or Kn, M, τ. The mean voltage across a heated wire is a function of velocity, density, and total temperature. The change in voltage across the wire can be expressed as change in u, ρ, T_o and the sensitivities of the wire. The sensitivities are the partial change in E with u, ρ, T_o and these partial changes can be expressed as changes in Nu_t and η with respect to the chosen independent variables. In addition the sensitivities can be obtained from the basic variables itself i.e., velocity, density, and total temperature. Because of the amount of data and the different possible methods for analyzing it, an outline of the data to be described is presented below:

1. Power vs. Velocity
2. $Nu_{t,corr}$ vs. Re_t
3. $Nu_{t,corr}$ vs. Kn
4. $Nu_{t,corr}$ vs. M
5. $Nu_{t,corr}$ vs. Kn for all D_w; M = 0.05 and 0.20
6. S_u vs. M; Morkovin's variables
7. S_ρ vs. M; Morkovin's variables

8. S_{T_o} vs. M; Morkovin's variables

9. S_u vs. M; Baldwin's variables

10. S_ρ vs. M; Baldwin's variables

11. S_{T_o} vs. M; Baldwin's variables

12. S_u vs. M; u, ρ, T_o variables

13. S_ρ vs. M; u, ρ, T_o variables

14. S_{T_o} vs. M; u, ρ, T_o variables

Power vs. Velocity

Plots of the power supplied (computed using equation 14) to the various diameter wires as a function of velocity for constant values of density and total temperature are presented for all of the probes in figures 4 through 6. These data for the parallel wire probe were corrected for an improper impedance which was noted after the tests were completed. The parallel wire voltage was corrected, E_{bc}, using the following equation:

$$\frac{E_{bc}}{E_{buc}} = \frac{R_t + R_w + R_\ell}{R_t + R_w + R_\ell + R_x} \tag{34}$$

where E_{buc} was uncorrect voltage, R_x was an extraneous lead resistance which was measured after the test and was assumed to be constant for the test.

Nearly all of the data correlate well as a straight line in log-log space with velocity except for two cases for the "Y" wire probe. These cases are T_o = 100°F, P_o = 1

atmosphere for all wire diameters and T_o = 80°F and T_o = 120°F, P_o = 1 atmosphere for d_w = 0.0005 inch diameter. For all of the data the slope $\frac{\partial \log P_w}{\partial \log u}$ appears to be somewhat less than 0.5. The slopes do approach 0.5 at the higher values of density.

$Nu_{t,corr}$ vs. Re_t

The Nusselt numbers, corrected for conduction to the supports of the wires, are presented in figure 7 through 9 as a function of Re_t for constant values of M. Also presented in the figures are examples of the corresponding data reported by Baldwin. The Nusselt numbers for all the present data are somewhat greater than the values reported by Baldwin. In addition the slopes for the present data are, in general, less than those for Baldwin's data. There is a fair agreement between the present data for the different probes over the range of test conditions.

The data for the 0.00015 inch diameter wire on the parallel wire probe indicate a variation of Nu_t with respect to M. This variation is not, however, as great as the variation for Baldwin's data. The data for the 0.00032 inch diameter wire on the parallel wire probe do not show a considerable variation of Nu_t with M. Since the plots of the power versus velocity correlates well, it is suspected that some of the problem with the data for the 0.00032 inch diameter wire is due to the end loss correction. The data for the 0.00050 inch diameter wire do not indicate a significant variation of Nu_t with respect to M. None of the

data for the "Y" wire probe show a significant variation of Nu_t with respect to M.

The data for the single wire show some variation of Nu_t with respect to M but the variation is not as great as the variation for the parallel wire probe or Baldwin's data.

For the present data, the results from two of the three probes indicate a variation of Nu_t with respect to M. However, this variation was somewhat less than the variation for Baldwin's data. It should be noted that the corrected values for Nu_t must be used to compare the present data with other data. However, the uncorrected data must be used to determine values for the sensitivities.

$Nu_{t,corr}$ vs. Kn

The present data along with Baldwin's data are presented in figures 10 through 12 in the form of Nu_t vs. Kn for constant values of M. In general, the slope of the present data, $\frac{\partial \log Nu_t}{\partial \log Kn}$, are less than the slopes for Baldwin's data. There is some scatter in the present data particularly for the 0.00032 inch diameter wire on the parallel wire probe. The present data along with Baldwin's data tend to correlate well in log-log space. This indicates that $\frac{\partial \log Nu_t}{\partial \log Kn}$ probably is not a function of Kn.

$Nu_{t,corr}$ vs. M

The present data and the data of Baldwin are presented in figures 13 through 15 in terms of Nu_t versus M for constant values of Kn. There is very little scatter in the present data when plotted in terms of these variables. In addition, the slope of the present data seem to agree well with those from Baldwin's data.

Comparison of $Nu_{t,corr}$ for different wire diameters

The corrected values of Nu_t are presented in figures 16 and 17 for the parallel wire and "Y" wire probes for the various diameter wires. These figures should indicate the accuracy of the correction for conduction for the various diameter wires. There is some scatter in the data for the wires indicating some possible error in the correction for conduction due to wire length. The scatter is not great, however, indicating that the possible errors are not significant. The data for the "Y" wire probe appear to have less scatter than for the parallel wire probe. This was probably due to the $\frac{\ell}{d_w}$'s for the "Y" wire probe being greater than those for the parallel wire probe and the corrections to the Nu_t being less for "Y" wire probe.

Hot-wire Sensitivities

The sensitivities can be computed for the different types of anemometers using three different methods. These methods should give identical results for the sensitivities of a given wire for a given type of anemometer. For a

constant temperature anemometer (CTA), the sensitivities can be obtained by using the assumption that $E = f(u,\rho,T_o)$ and evaluating the sensitivities by taking the partial change in E with respect to u, ρ and T_o in turn. That is:

$$S_u = \left(\frac{\partial \log E}{\partial \log u} \right)_{\rho, T_o, T_w} \tag{39}$$

$$S_\rho = \left(\frac{\partial \log E}{\partial \log \rho} \right)_{u, T_o, T_w} \tag{40}$$

and

$$S_{T_0} = \left(\frac{\partial \log E}{\partial \log T_o} \right)_{u, \rho, T_w} \tag{41}$$

To evaluate the sensitivities, some knowledge of the relationship between the mean voltage and the independent variables (u,ρ,T_o) must be known or assumed. In reference 14 a log relationship between the dependent and independent variables was assumed. This relationship appeared to result in a reasonable curve fit to the data. However, subsequent data at low Mach number revealed that this functional relationship might not be adequate. It appears that the best technique available for obtaining the sensitivities requires that two of the variables be held constant while the other variable is varied. This technique was described in reference 15 but cross plotting the data resulted in unreasonable variation of voltage with ρ and T_o. It appears that a better result can be obtained by plotting voltage versus velocity with ρ and T_o constant to obtain S_u. Then plotting voltage versus ρ with u and T_o constant to obtain

S_ρ. The same procedure is to be used to obtain S_{T_o}. When this technique was used, based on the curve fitting as described in latter sections, the sensitivities obtained were function of the three independent variables u, ρ and T_o. This result was not obtained in reference 15. In this reference S_u was independent of u, S_ρ independent of ρ and S_{T_o} independent of T_o.

This method of obtaining the sensitivities is very time consuming when conducting experiments in a large wind tunnel since the Mach number and total pressures must be varied to maintain the non-varying independent variable constant when the variation of E with the other independent variable is sought.

The above technique should also be used when the sensitivities are to be evaluated using M, Kn, and τ or M, Re_t, and θ. However, holding two of these independent variable constant while varying the remaining variable is even more difficult in terms of tunnel operation than the technique described previously.

The method of curve fitting used in the present study for a given set of data depended on the variation of the dependent variable with respect to the independent variable. Here, the technique which gave the "best curve fit" to the data was used. The methods used included a polynomial fit of the dependent variable to an independent variable with the other independent variables held constant, a log-log fit, and a step wise local fit where a second degree curve was fitted to the data points.

In using $E = f(u,\rho,T_o)$ a second degree polynomial curve fit was used for computing partial of voltage with respect to velocity while holding density and total temperature constant. For voltage with respect to density a linear curve fit was used while holding velocity and total temperature constant. Again, for voltage with respect to total temperature, a linear curve fit was used while holding velocity and density constant.

In using $Nu_t = f(M,Kn,\tau)$, a second degree polynomial curve fit was used for computing partials of Nusselt number with respect to Mach number while holding other independent variables constant. For computing partials of Nusselt number with respect to Knudsen number and temperature parameter, a linear curve fit was used while holding corresponding independent variables constant.

It was found that in using Morkovin's variables where $Nu_t = f(M,Re_t,\theta)$, for computing the partials (equations A-55 thru A-57) required to compute sensitivities of the hot wire, the present set of data was inadequate over the range of Reynolds number. Thus, it was not possible to compute sensitivities using Morkovin's variables and no data is presented using these variables.

Velocity Sensitivity

The velocity sensitivities for the parallel wire probe obtained by assuming that $Nu_t = f(M,Kn,\tau)$ and $E = f(u,\rho,T_o)$ is presented in figures 18 and 19 respectively along with values obtained from Baldwin's data. Both sets of data indicate that S_u ranges from about 0.1 to 0.2 and

for much of the data S_u do not vary significantly with velocity except at 80°F for wire diameters 0.00032 and 0.00050 inches where a few lower S_u values were observed.

The velocity sensitivities for the "Y" wire probe are presented in figures 20 through 21. Again S_u ranges between 0.1 to 0.2, however, for the 0.00032 inch diameter wire many of the S_u values lie above the 0.2 value. This is probably due to the scatter in the data as noted in the section Power vs. Velocity.

The values for S_u for the single wire probe are presented in figures 22 through 23. Here the values of S_u range from about 0.1 to 0.2 and in many cases S_u is not a significant function of velocity.

Density Sensitivities

The density sensitivities obtained by assuming that $Nu_t = f(M,Kn,\tau)$ and $E = f(u,\rho,T_o)$ are presented in figures 24 through 29 respectively. Nearly all of the values of S_ρ ranged from about 0.2 to 0.3. Most of the values of S_ρ obtained using Baldwin's data also fell into this range.

Velocity sensitivity versus Density sensitivity

It has been shown that, if $S_u \neq S_\rho$ at low subsonic speeds, the heated wire is operating in the slip flow regime. To investigate the possibility that the wires used in the present test were operating in the slip flow regime,

plots of S_u versus S_ρ were made and the results are presented in figures 30 through 35.

When the data for the parallel wire probe were correlated assuming that $E = f(u,\rho,T_o)$, the values of S_u were almost always less than S_ρ. The values of S_u approach the values of S_ρ only at higher pressures. Sensitivities obtained from Baldwin's data are also shown on the plots for comparison. For Baldwin's data the values of S_ρ nearly always exceeded the values of S_u.

For the present data, some of the values of S_u exceeded the values of S_ρ. Possible scatter in curve fitting could cause this result. Also, if King's law is assumed in its most general form and variation in all the variables are permitted, it can be shown that S_ρ is always greater than S_u.

When the present data were correlated using Baldwin's variables, there were more cases where $S_u < S_\rho$. This is particularly true for the 0.00050 inch diameter wire on the parallel wire probe and for all of the wires on the "Y" wire probe. S_u is also greater than S_ρ for some cases of the single wire data at higher pressures.

Temperature Sensitivity

The temperature sensitivities for the present data and Baldwin's data are presented in figures 36 through 41. There are significant difference between S_{T_o} computed from the present data and those obtained from Baldwin's results. Most of these differences are probably due to the limited extent of the temperature variation for the present data. All the values of S_{T_o} are less than zero. However, the value of S_{T_o} from Baldwin data range between -0.5 and 0.0, where as, the present data vary over a much greater range. Some values of S_{T_o} for the present data approach -2.0.

Comparison of Sensitivities

A comparison of the sensitivities for the present data obtained from $E = f(u,\rho,T_o)$ and those obtained using Baldwin's variables are presented in figures 42 through 50. Figure 42 through 44 shows that there is a very good agreement between the values of S_u obtained by the two methods for all three types of probes.

The values for S_ρ computed using the relationship $E = f(u,\rho,T_o)$ and using Baldwin's variables are presented in figures 45-47. The values for S_ρ for the Y-wire probe computed using $E = f(u,\rho,T_o)$ are sometimes greater than those obtained using Baldwin's variables. The reason for this disagreement is not understood since $S_\rho = \frac{\partial E_w}{\partial \rho}$ for E =

$f(u,\rho,T_o)$ and $S_\rho = -\frac{\partial Nu_t}{\partial Kn}$ for Baldwin's variables. An evaluation of S_ρ for Baldwin's variables shows that $-\frac{\partial Nu_t}{\partial Kn} = \frac{\partial Nu_t}{\partial \rho}$ and $Nu_t \propto E_w$, therefore, except for the constant value in the equation for Nu_t, the two techniques should result in identical values for S_ρ. The reason for this disagreement is possible due to curve fitting technique.

The values of S_{T_o} computed by the two techniques are presented in figures 48 to 50. There are significant differences between the values of S_{T_o} obtained from the two techniques. Again this difference is not understood since for Baldwin's variables S_{T_o} is related to S_u by the addition of only the term $\frac{\partial Nu_t}{\partial \tau}$ and $\frac{\partial k_t}{\partial T_o}$. The good agreement between the values of S_u obtained by the two methods would lead one to expect good agreement between the values of S_{T_o}. However, as noted in earlier section the range of total temperature data in the present study is limited.

In any case the sensitivities obtained using the relationship $E = f(u,\rho,T_o)$ probably should result in more accurate values for the sensitivities since less information is required to obtain the sensitivities than the method using Baldwin's variables. For example, the temperature - resistance relationship for the wire, the wire length, and the recovery temperature ratio are required when Baldwin variables are used and there are the possibilities for error in obtaining these values.

Application of Results to Constant Temperature Hot Wire Anemometry

The sensitivity equation applicable for hot wire anemometry were derived in the Appendix-A from the heat transfer equation (20) and the relationship for the recovery temperature ratio equation (13). Equation A-44 can be expressed as follows if the small perturbation assumption is made:

$$\frac{e'}{E} = S_u \frac{u'}{u} + S_\rho \frac{\rho'}{\rho} + S_{T_o} \frac{T_o'}{T_o} \tag{35}$$

Therefore, in general, only one equation with three unknowns is available to determine u', ρ', and T_o' from e'. At low speeds in continuum flow, it is generally accepted that S_u = S_ρ and the above equation reduces to:

$$\frac{e'}{E} = S_m \frac{m'}{m} + S_{T_o} \frac{T_o'}{T_o} \tag{36}$$

since

$$\frac{m'}{m} = \frac{u'}{u} + \frac{\rho'}{\rho} \tag{37}$$

If it can be shown that $S_{T_o} \frac{T_o'}{T} << S_m \frac{m'}{m}$ then the mass flow fluctuations can be obtained from:

$$\frac{e'}{E} = S_m \frac{m'}{m} \tag{38}$$

If there is significant total temperature fluctuation, a constant current anemometer can be used to obtain the mass flow and total temperature fluctuations by using the mode diagram technique of Kovasany (12).

Since $S_u \neq S_\rho$ for subsonic slip flows and transonic flows the voltage measured across a wire is a function of three variables u, ρ, and T_o. Therefore, the three-wire technique proposed for use in transonic flows ref.(14) might be adapted for subsonic slip flows to measure fluctuation of velocity, density and total temperature. This application would require that the sensitivities for the three wires be sufficiently different to make the system of three equations well conditioned[16]. The sensitivities for the wires can be obtained for a CCA and CTA by using equation A-(43-45) and A-(49-51) respectively.

Conclusion

From tests conducted in the Langley Research Center Low Turbulence Pressure Tunnel using a single wire probe and two three-wire probes with constant temperature anemometers the following conclusion can be made:

1. The data in terms of power versus velocity correlated well on a straight line in log-log space. The slopes of these curve were less than 0.5 but approached 0.5 at the higher diameter wires.

2. The present values of $Nu_{t,corr}$ were higher than those reported by Baldwin.

3. For the 0.00015 inch diameter wire in the parallel wire probe and in the single wire probe indicated that $Nu_{t,corr} = f(Re_t, M)$.

4. For all the other probe configurations and wire sizes, there was no significant variation of $Nu_{t,corr}$ with Mach number.

5. The data correlated well in terms of
   $Nu_{t,corr} = f(M)$ at constant Kn and
   $Nu_{t,corr} = f(Kn)$ at constant M.

6. The velocity sensitivities usually ranged from 0.1 to 0.2 where as the density sensitivities usually ranged from 0.2 to 0.3.

7. For most of the current data set, $S_\rho > S_u$ indicating the presence of slip flow effect in the heat transfer from the wires.

8. There was a good agreement between S_u obtained from $E = f(u, \rho, T_o)$ and S_u obtained from Baldwin's variables.

9. The agreement between S_ρ using two correlation methods are better than agreement between S_{T_o} but is not as good as agreement between S_u.

10. The agreement between S_{T_o} using the two correlation methods did not agree as well as the values for S_u.

11. It appears that if the matrix of the sensitivity coefficient is well conditioned, it might be possible to apply the three wire technique developed for transonic flows to subsonic slip flows.

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Appendix-A

The heat transfer equation describing the heat loss from a heated wire mounted normal to the flow can be used to obtain sensitivity relationships for use in hot wire anemometry. It is usually assumed that this equation can be written as follows:

$$Q_w = \pi \ell k_t (T_w - \eta T_o) Nu_t \qquad \text{A-(1)}$$

For steady state conditions the electrical power supplied to the wire equals the heat loss from the wire. Therefore, equation A-(1) becomes

$$P_w = Q_w = \pi \ell k_t (T_w - \eta T_o) Nu_t$$

Differentiating this equation in terms of log derivatives gives:

$$d\log Q_w = d\log Nu_t - \frac{\eta}{\tau} d\log T_o - \frac{\eta}{\tau} d\log \eta + \frac{\theta}{\tau} d\log T_w + d\log k_t \qquad \text{A-(2)}$$

The voltage across the heated wire is assumed to be a function of velocity, density, total temperature and wire temperature. Therefore, equation A-(2) will be recast in terms of these variables.

Following the assumption in ref. 8 and 9, $Nu_t = f(M, Kn, \tau)$ and the change in Nu_t is :

$$d\log Nu_t = \frac{\partial \log Nu_t}{\partial \log M} d\log M + \frac{\partial \log Nu_t}{\partial \log Kn} d\log Kn + \frac{\partial \log Nu_t}{\partial \log \tau} \log \tau \qquad \text{A-(3)}$$

The Mach number is a function of u and T_o so :

$$\text{dlogM} = \frac{\partial \log M}{\partial \log u}\,\text{dlogu} + \frac{\partial \log M}{\partial \log T_o}\,\text{dlogT}_o \qquad \text{A-(4)}$$

$$\text{dlogM} = (1 + \frac{\gamma-1}{2} M^2)\ \text{dlogu} - \frac{1}{2}\ (1 + \frac{\gamma-1}{2} M^2)\ \text{dlogT}_o \qquad \text{A-(5)}$$

The Knudsen number is a function of only density for a given wire diameter, and can be expressed as:[8]

$$Kn = \frac{1.587 \times 10^{-8}}{\rho d_w} \qquad \text{A-(6)}$$

and

$$\text{dlogKn} = -\text{dlog}\rho \qquad \text{A-(7)}$$

The recovery temperature ratio, η, is assumed to be a function of M and Kn, then:

$$\text{dlog}\eta = \frac{\partial \log\eta}{\partial \log M}\,\text{dlogM} + \frac{\partial \log\eta}{\partial \log Kn}\,\text{dlogKn} \qquad \text{A-(8)}$$

$$\text{dlog}\eta = [(1 + \frac{\gamma-1}{2} M^2)\ \text{dlogu} - \frac{1}{2}\ (1 + \frac{\gamma-1}{2} M^2)\ \text{dlogT}_o]\ \frac{\partial \log\eta}{\partial \log M}$$

$$- \frac{\partial \log\eta}{\partial \log Kn}\,\text{dlog}\rho \qquad \text{A-(9)}$$

The quantity $\tau = \dfrac{T_w - \eta\ T_o}{T_o}$, therefore, the change in τ is:

$$d\log\tau = -\frac{\theta}{\tau}\, d\log T_o - \frac{\eta}{\tau}\, d\log\eta + \frac{\theta}{\tau}\, d\log T_w$$

or A-(10)

$$d\log\tau = -\frac{\theta}{\tau}\, d\log T_o + \frac{\theta}{\tau}\, d\log T_w -$$

$$\frac{\eta}{\tau}\left[\frac{\partial \log M}{\partial \log u}\, d\log u + \frac{\partial \log M}{\partial \log T_o}\, d\log T_o - \frac{\partial \log\eta}{\partial \log Kn}\, d\log\rho\right]$$

The thermal conductivity of air is evaluated at T_o and :

$$d\log k_t = \frac{\partial \log k_t}{\partial \log T_o}\, d\log T_o \qquad \text{A-(11)}$$

Equations A-(9) through A-(11) can be substituted into A-(2) to give:

$$d\log Q_w = S'_u d\log u + S'_\rho d\log\rho + S'_{T_o} d\log T_o + S'_{T_w} d\log T_w \qquad \text{A-(12)}$$

where

$$S'_u = \left(1 + \frac{\gamma-1}{2} M^2\right)\left[\frac{\partial \log Nu_t}{\partial \log M} - \frac{\eta}{\tau}\ \frac{\partial \log\eta}{\partial \log M}\left(\frac{\partial \log Nu_t}{\partial \log\tau} + 1\right)\right] \qquad \text{A-(13)}$$

$$S'_\rho = -\frac{\partial \log Nu_t}{\partial \log Kn} + \frac{\eta}{\tau}\,\frac{\partial \log\eta}{\partial \log Kn}\left(\frac{\partial \log Nu_t}{\partial \log\tau} + 1\right) \qquad \text{A-(14)}$$

$$S'_{T_o} = -S'_u - \left(1 + \frac{\eta}{\tau}\right)\frac{\partial \log Nu_t}{\partial \log\tau} - \frac{\eta}{\tau} + \frac{\partial \log k_t}{\partial \log T_o} \qquad \text{A-(15)}$$

$$S'_{T_w} = \frac{\theta}{\tau}\left(1 + \frac{\partial \log Nu_t}{\partial \log\tau}\right) \qquad \text{A-(16)}$$

For a constant current anemometer, the change in power can be expressed as:

$$d\log P_w = d\log R_w + 2d\log I_w \qquad \text{A-(17)}$$

Following Morkovin[7], the change in the power can be expressed as:

$$d\log P_w = \left(1 + 2\,\frac{\partial \log I_w}{\partial \log R_w}\right) d\log R_w \qquad \text{A-(18)}$$

The resistance of the wire is a function of the wire temperature, therefore:

$$d\log R_w = \frac{\partial \log R_w}{\partial \log T_w}\, d\log T_w \qquad \text{A-(19)}$$

or

$$d\log R_w = K\, d\log T_w \qquad \text{A-(20)}$$

Let

$$\frac{\partial \log I_w}{\partial \log R_w} = -\epsilon \qquad \text{A-(21)}$$

Then

$$d\log P_w = (1 - 2\epsilon)\, K\, d\log T_w \qquad \text{A-(22)}$$

Equation A-(12) can now be expressed as:

$$\left[(1 - 2\epsilon)K - \frac{\theta}{\tau}\left(\frac{\partial \log Nu_t}{\partial \log \tau} + 1\right)\right] d\log T_w = RHS \qquad \text{A-(23)}$$

The change in voltage across the wire is:

$$\mathrm{dlog}E_w = \mathrm{dlog}I_w + \mathrm{dlog}R_w \qquad \text{A-(24)}$$

or

$$\mathrm{dlog}E_w = (1-\epsilon)\ K\ \mathrm{dlog}T_w \qquad \text{A-(25)}$$

Substituting equation A-(25) into A-(23) gives:

$$\left[(1 - 2\epsilon)K - \frac{\theta}{\tau}\ \left(\frac{\partial \log Nu_t}{\partial \log\tau} + 1 \right)\right] \frac{\partial \log E}{(1-\epsilon)K} = \text{RHS} \qquad \text{A-(26)}$$

For constant values of u, ρ, and T_o the RHS of equation A-(26) is zero. Therefore:

$$\frac{\theta}{\tau} \left(\frac{\partial \log Nu_t}{\partial \log\tau} + 1 \right) = (1 - 2\epsilon)K \qquad \text{A-(27)}$$

Using equation A-(21), the above equation becomes:

$$\frac{\theta}{\tau} \left(\frac{\partial \log Nu_t}{\partial \log\tau} + 1 \right) = \left(1 + \frac{2}{\dfrac{\partial \log R_w}{\partial \log I_w}} \right) K \qquad \text{A-(28)}$$

Let

$$A_w' = \frac{1}{2} \left(\frac{\partial \log R_w}{\partial \log I_w} \right)_{u,\rho,T_o} \qquad \text{A-(29)}$$

Then

$$\frac{\theta}{\tau} \left(\frac{\partial \log Nu_t}{\partial \log\tau} + 1 \right) = \left(1 + \frac{1}{A_w'} \right) K \qquad \text{A-(30)}$$

Substituting equation A-(30) into A-(26) gives:

$$[(1 - 2\epsilon) - (1 + \frac{1}{A_w'})] \frac{\partial \log E}{(1-\epsilon)} = \text{RHS} \qquad \text{A-(31)}$$

Let

$$E' = \frac{(1 - \epsilon)}{(1 + 2\epsilon A_w')} \qquad \text{A-(32)}$$

then equation A-(31) becomes:

$$\frac{-1}{E' A_w'} \, d\log E = \text{RHS} \qquad \text{A-(33)}$$

For a constant current anemometer the change in voltage can then be expressed as[7]:

$$d\log E = - S_u d\log u - S_\rho d\log \rho + S_{T_o} d\log T_o \qquad \text{A-(34)}$$

where

$$S_u = - S_u' E' A_w' \qquad \text{A-(35)}$$

$$S_\rho = - S_\rho' E' A_w' \qquad \text{A-(36)}$$

$$S_{T_o} = + S_{T_o}' E' A_w' \qquad \text{A-(37)}$$

Using equation A-(30) we have:

$$\frac{\partial \log Nu_t}{\partial \log \tau} = \frac{\tau K}{A_w' \theta} (A_w' + 1) - 1 \qquad \text{A-(38)}$$

Then the sensitivities become:

$$S_u'' = (1 + \frac{\gamma-1}{2} M^2)\{\frac{\partial \log Nu_t}{\partial \log M} - \frac{\eta K}{A_w'\theta} (A_w' + 1) \frac{\partial \log \eta}{\partial \log M}\} \qquad A-(39)$$

$$S_\rho'' = - \frac{\partial \log Nu_t}{\partial \log Kn} + \frac{\eta K}{A_w'\theta} (A_w' + 1) \frac{\partial \log \eta}{\partial \log Kn} \qquad A-(40)$$

$$S_{T_o}'' = - \frac{1}{2} S_u'' - \frac{K}{A_w'} (1 + A_w') + 1 + \frac{\partial \log k_t}{\partial \log T_o} \qquad A-(41)$$

Finally for a CCA the change in voltage becomes

$$d\log E = S_u d\log u + S_\rho d\log \rho + S_{T_o} d\log T_o \qquad A-(42)$$

where

$$S_u = - S_u'' E' A_w' \qquad A-(43)$$

$$S_\rho = - S_\rho'' E' A_w' \qquad A-(44)$$

$$S_{T_o} = + S_{T_o}'' E' A_w' \qquad A-(45)$$

The power to the heated wire can also be written as:

$$d\log P_w = d\log E_w - d\log R_w \qquad A-(46)$$

For a constant temperature anemometer:

$$d\log R_w = 0 \qquad A-(47)$$

Then for a constant temperature anemometer equation A-(34) becomes:

$$d\log E_w = S_u d\log u + S_\rho d\log\rho + S_{T_o} d\log T_o \qquad \text{A-(48)}$$

where

$$S_u = S_u'/2 \qquad \text{A-(49)}$$

$$S_\rho = S_\rho'/2 \qquad \text{A-(50)}$$

$$S_{T_o} = S_{T_o}'/2 \qquad \text{A-(51)}$$

The above equation for the sensitivities of a constant temperature anemometer are different from those in references 8 and 9 for several reasons. In these references the velocity sensitivity has a term for $\frac{\partial T_o}{\partial u}$ under the constraints that T_o = constant. There are other terms missing due to the incomplete partial differentiation process. The equation for the sensitivities for CCA and CTA were derived using Morkovin's variables in reference 7 and 16. The equations are repeated here for convenience.

$$S_\rho = \frac{1}{2}\left[\frac{\partial\log Nu_t}{\partial\log Re_t} - \frac{1}{\tau_{wr}}\frac{\partial\log\eta}{\partial\log Re_t}\right] \qquad \text{A-(52)}$$

$$S_u = \left\{ S_\rho + \frac{1}{2\alpha}\left[\frac{\partial\log Nu_t}{\partial\log M} - \frac{1}{\tau_{wr}}\frac{\partial\log\eta}{\partial\log M}\right]\right\} \qquad \text{A-(53)}$$

$$S_{T_o} = \frac{1}{2}\left[n_t + 1 - m_t \frac{\partial \log Nu_t}{\partial \log Re_t} - \left\{ \frac{\partial \log Nu_t}{\partial \log \theta} + \frac{\theta}{\theta - \eta} \right\} + \right.$$

A-(54)

$$\left. \frac{1}{\tau_{wr}} \left\{ \frac{1}{2\alpha} \frac{\partial \log \eta}{\partial \log M} + m_t \frac{\partial \log \eta}{\partial \log Re_t} \right\} - \frac{1}{2\alpha} \frac{\partial \log Nu_t}{\partial \log M} \right]$$

For sake of completeness the equations for a constant current anemometer using Morkovin's variables are repeated here. They are as follows:

$$S_u = E' A_w' \left[\frac{\partial \log Nu_t}{\partial \log Re_t} + \frac{1}{\alpha} \frac{\partial \log Nu_t}{\partial \log M} - \frac{1}{\tau_{wr}} \left\{ \frac{1}{\alpha} \frac{\partial \log \eta}{\partial \log M} + \frac{\partial \log \eta}{\partial \log Re_t} \right\} \right]$$

A-(55)

$$S_\rho = E' A_w' \left[\frac{\partial \log Nu_t}{\partial \log Re_t} - \frac{1}{\tau_{wr}} \frac{\partial \log \eta}{\partial \log Re_t} \right] \qquad \text{A-(56)}$$

$$S_{T_o} = E' \left[K + A_w' \left\{ K - 1 - n_t + m_t \frac{\partial \log Nu_t}{\partial \log Re_t} + \frac{1}{2\alpha} \frac{\partial \log Nu_t}{\partial \log M} \right\} \right.$$

$$\left. - \frac{A_w'}{\tau_{wr}} \left\{ \frac{1}{2\alpha} \frac{\partial \log \eta}{\partial \log M} + m_t \frac{\partial \log \eta}{\partial \log Re_t} \right\} \right] \qquad \text{A-(57)}$$

Appendix-B

In this section the raw data along with other quantities of interest and sensitivities computed using local curve fit method are tabulated for "Y" wire probe, parallel wire probe and single wire probe.

The following units are used in defining the values of tables II.1 to II.9 (from page 40 through 52):

Symbol	Meaning	Units
Vel	Velocity	ft/sec
Den	Density	lbm/ft^3
To	Total Temperature	°F
E	Voltage	Volts

Table II.1 Raw data along with other quantities of interest for Y-wire probe

Wire diameter = 0.00015 inch; Wire temperature = 1006 F

obs	vel	den	To	E	Mach	Re	Theta	Kn	Tau	Nu,cor	Nu"	Recovery
5.	422.7	.06780	562.4	7.31	.369	27.99	1.788	.01873	.7919	3.535	3.706	.99133
6.	401.0	.06836	560.4	7.26	.350	26.84	1.794	.01857	.8054	3.029	3.187	.99192
7.	345.0	.06908	560.9	7.09	.300	23.32	1.793	.01838	.8018	3.229	3.392	.99340
8.	288.1	.06983	560.0	6.91	.250	19.71	1.795	.01818	.8030	3.294	3.459	.99478
9.	232.8	.07183	558.1	6.70	.202	16.43	1.802	.01768	.8058	3.098	3.259	.99600
10.	173.2	.07152	560.2	6.37	.150	12.14	1.795	.01775	.7960	2.796	2.949	.99722
11.	116.4	.07165	558.9	5.97	.101	8.18	1.799	.01772	.7978	2.448	2.592	.99826
12.	58.7	.07166	558.6	5.35	.051	4.13	1.800	.01772	.7973	1.956	2.087	.99921
13.	58.1	.07437	538.4	5.44	.052	4.36	1.867	.01707	.8674	2.004	2.135	.99919
14.	113.7	.07443	538.4	6.07	.100	8.55	1.867	.01706	.8643	2.510	2.656	.99827
17.	228.2	.07432	540.2	6.81	.201	17.08	1.861	.01708	.8625	3.166	3.328	.99602
18.	284.0	.07381	540.4	7.05	.251	21.11	1.861	.01720	.8622	3.396	3.563	.99475
19.	339.4	.07337	542.0	7.24	.300	25.02	1.855	.01730	.8597	3.586	3.757	.99339
20.	392.6	.07236	543.6	7.38	.348	28.48	1.850	.01754	.8571	3.728	3.902	.99198
29.	427.8	.06638	582.3	7.17	.367	27.01	1.727	.01913	.7388	3.444	3.613	.99140
30.	350.7	.06766	580.3	6.98	.300	22.63	1.733	.01877	.7480	3.271	3.435	.99341
31.	292.5	.06830	580.5	6.79	.249	19.04	1.732	.01859	.7392	3.094	3.255	.99480
33.	236.8	.06884	580.2	6.57	.201	15.55	1.733	.01844	.7397	2.896	3.052	.99601
34.	177.2	.06927	580.0	6.27	.150	11.71	1.733	.01833	.7427	2.632	2.781	.99720
35.	120.3	.06975	578.6	5.89	.102	8.02	1.738	.01820	.7418	2.318	2.459	.99823
36.	59.2	.06978	580.0	5.25	.050	3.94	1.733	.01819	.7334	1.829	1.956	.99922
38.	118.3	.14600	555.2	6.95	.103	17.03	1.801	.00870	.8059	3.239	3.405	.99822
40.	58.6	.14562	560.7	6.12	.050	8.33	1.783	.00872	.7989	2.511	2.657	.99921
41.	174.9	.14485	559.8	7.40	.151	24.83	1.786	.00877	.8041	3.698	3.873	.99719
42.	231.1	.14364	560.4	7.76	.200	32.51	1.784	.00884	.8032	4.066	4.249	.99605
43.	290.1	.14223	561.3	8.05	.251	40.36	1.781	.00893	.8030	4.384	4.573	.99474
44.	346.0	.14053	558.9	8.24	.301	47.70	1.788	.00903	.7887	4.577	4.772	.99336
45.	385.1	.13908	561.7	8.35	.335	52.35	1.780	.00913	.7888	4.710	4.907	.99236
46.	118.0	.14309	580.3	6.70	.100	16.10	1.722	.00887	.7314	3.068	3.230	.99827
47.	60.3	.14332	579.5	5.97	.051	8.25	1.725	.00886	.7250	2.414	2.560	.99920
48.	176.9	.14240	579.8	7.20	.150	24.03	1.724	.00892	.7293	3.545	3.718	.99721
49.	236.2	.14127	580.2	7.56	.201	31.82	1.723	.00899	.7307	3.918	4.099	.99603
50.	294.1	.13991	579.7	7.85	.251	39.27	1.724	.00907	.7322	4.219	4.407	.99476
51.	114.3	.17928	540.5	7.14	.100	20.64	1.850	.00708	.8399	3.397	3.567	.99826
52.	340.3	.17300	541.5	8.61	.301	59.18	1.846	.00734	.8433	4.962	5.164	.99337
54.	284.5	.17404	540.5	8.38	.251	49.85	1.849	.00729	.8449	4.703	4.900	.99474
55.	228.0	.17552	538.5	8.09	.201	40.40	1.856	.00723	.8520	4.377	4.568	.99602
56.	170.6	.17659	539.7	7.69	.150	30.37	1.852	.00719	.8513	3.950	4.132	.99721
57.	57.1	.17790	540.2	6.34	.050	10.22	1.850	.00714	.8504	2.669	2.821	.99922
58.	57.7	.30473	539.4	7.06	.051	17.73	1.948	.00417	.9483	2.981	3.141	.99921
59.	114.3	.30379	539.8	7.98	.101	35.01	1.947	.00418	.9477	3.833	4.013	.99826
60.	171.3	.30146	540.0	8.58	.151	52.03	1.946	.00421	.9474	4.440	4.632	.99719
61.	227.6	.29895	539.7	9.05	.201	68.57	1.947	.00425	.9489	4.946	5.148	.99603
62.	284.3	.29490	542.9	9.43	.250	84.12	1.936	.00431	.9412	5.380	5.590	.99476
63.	306.1	.29325	543.6	9.57	.270	89.96	1.934	.00433	.9400	5.535	5.748	.99424
64.	305.8	.29140	561.3	9.45	.265	87.16	1.872	.00436	.8777	5.426	5.637	.99437
65.	232.3	.29457	562.0	8.93	.201	66.86	1.870	.00431	.8765	4.844	5.044	.99603
66.	173.4	.29631	560.7	8.46	.150	50.30	1.875	.00428	.8787	4.347	4.537	.99722
67.	115.6	.29740	558.7	7.87	.100	33.74	1.881	.00427	.8807	3.751	3.929	.99827
68.	58.8	.29774	558.2	6.97	.051	17.20	1.883	.00426	.8826	2.921	3.080	.99920
69.	235.5	.29452	580.9	8.83	.200	66.09	1.809	.00431	.8124	4.779	4.978	.99604
70.	294.2	.29166	582.5	9.22	.250	81.59	1.804	.00435	.8081	5.220	5.428	.99477
71.	177.5	.29619	578.2	8.39	.151	50.28	1.818	.00429	.8204	4.303	4.493	.99719
72.	119.0	.29708	578.2	7.80	.101	33.80	1.818	.00427	.8215	3.715	3.892	.99825
73.	60.0	.29708	579.1	6.88	.051	17.01	1.815	.00427	.8150	2.877	3.035	.99920
74.	236.0	.55865	581.3	10.24	.200	125.55	1.774	.00227	.7780	6.756	6.990	.99604
75.	177.1	.56108	581.4	9.68	.150	94.64	1.774	.00226	.7739	6.026	6.248	.99721
76.	119.2	.56179	580.7	8.88	.101	63.82	1.776	.00226	.7759	5.066	5.271	.99825
77.	59.8	.56091	580.2	7.79	.051	31.97	1.778	.00226	.7776	3.873	4.054	.99921
78.	58.7	.56214	562.7	7.87	.050	32.21	1.833	.00226	.8349	3.922	4.103	.99921
79.	116.8	.55853	560.5	8.97	.101	63.89	1.840	.00227	.8382	5.109	5.315	.99825
80.	174.4	.57286	561.1	9.86	.151	97.74	1.838	.00222	.8363	6.182	6.407	.99720
81.	232.5	.56698	560.9	10.24	.201	128.97	1.838	.00224	.8375	6.676	6.910	.99602
82.	57.6	.59661	541.1	8.03	.051	34.58	1.906	.00213	.9060	4.052	4.235	.99921
83.	114.6	.59209	542.1	9.12	.100	68.14	1.902	.00214	.9010	5.249	5.457	.99826
84.	171.0	.58710	541.6	9.94	.150	100.91	1.904	.00216	.9041	6.251	6.476	.99721
85.	227.8	.58093	544.3	5.95	.200	132.50	1.895	.00219	.8974	2.178	2.317	.99605
89.	57.1	.03683	540.7	4.68	.050	2.11	1.788	.03447	.7883	1.534	1.652	.99922
90.	114.7	.03691	538.5	5.18	.101	4.28	1.795	.03440	.7924	1.891	2.021	.99825
91.	170.8	.03682	539.6	5.49	.150	6.34	1.792	.03448	.7879	2.133	2.270	.99720
92.	228.0	.03664	540.5	5.73	.201	8.41	1.789	.03465	.7894	2.327	2.470	.99603
93.	283.5	.03643	540.7	5.91	.250	10.39	1.788	.03485	.7865	2.481	2.628	.99477
94.	339.0	.03615	540.7	6.07	.300	12.33	1.788	.03512	.7874	2.610	2.760	.99340
95.	393.9	.03573	541.4	6.18	.350	14.15	1.786	.03554	.7863	2.709	2.862	.99193
96.	401.0	.03562	560.5	6.12	.350	13.98	1.725	.03564	.7314	2.693	2.845	.99192
97.	344.2	.03619	560.1	6.00	.299	12.20	1.726	.03509	.7329	2.590	2.739	.99342
98.	287.5	.03659	559.8	5.86	.249	10.31	1.727	.03470	.7315	2.472	2.619	.99479
99.	232.1	.03702	559.2	5.69	.201	8.43	1.729	.03430	.7305	2.329	2.472	.99602
100.	59.5	.03672	580.2	4.55	.050	2.08	1.666	.03458	.6664	1.503	1.622	.99921
101.	118.4	.03694	580.1	5.04	.100	4.17	1.667	.03437	.6683	1.851	1.980	.99826
102.	177.8	.03703	578.5	5.38	.151	6.29	1.671	.03428	.6737	2.110	2.248	.99719
103.	236.5	.03706	577.3	5.62	.202	8.39	1.675	.03426	.6751	2.307	2.450	.99601
104.	294.4	.03682	583.5	5.78	.250	10.29	1.657	.03449	.6670	2.457	2.604	.99477
105.	349.9	.03731	582.6	5.97	.298	12.41	1.660	.03402	.6680	2.615	2.767	.99345
106.	403.5	.03705	580.8	6.10	.346	14.25	1.665	.03427	.6737	2.727	2.881	.99204
107.	173.6	.03903	558.8	5.51	.150	6.65	1.730	.03253	.7292	2.177	2.316	.99721
108.	117.2	.03927	557.0	5.20	.101	4.53	1.736	.03233	.7352	1.929	2.060	.99824
109.	59.2	.03926	561.6	4.69	.051	2.27	1.722	.03234	.7220	1.564	1.684	.99920

Wire diameter = 0.00032 inch; Wire Temperature = 929 F

obs	vel	den	To	E	Mach	Re	Theta	Kn	Tau	Nu,cor	Nu"	Recovery
5.	422.7	.06780	562.4	12.20	.369	59.71	1.648	.00878	.6475	4.273	4.665	.99136
6.	401.0	.06836	560.4	12.14	.350	57.27	1.654	.00871	.6653	3.555	3.916	.99211
7.	345.0	.06908	560.9	11.85	.300	49.75	1.653	.00862	.6617	3.875	4.249	.99397
8.	288.1	.06983	560.0	11.52	.250	42.05	1.655	.00852	.6626	4.011	4.390	.99560
9.	232.8	.07183	558.1	9.15	.202	35.04	1.661	.00829	.6619	2.459	2.772	.99697
10.	173.2	.07152	560.2	10.58	.150	25.89	1.655	.00832	.6532	3.363	3.717	.99822
11.	116.4	.07165	558.9	9.89	.101	17.45	1.658	.00831	.6546	2.921	3.254	.99918
12.	58.7	.07166	558.6	8.84	.051	8.81	1.659	.00831	.6488	2.295	2.598	.99994
13.	58.1	.07437	538.4	9.04	.052	9.30	1.721	.00800	.7215	2.356	2.661	.99992
14.	113.7	.07443	538.4	10.13	.100	18.23	1.721	.00800	.7214	3.004	3.340	.99919
17.	228.2	.07432	540.2	11.39	.201	36.43	1.716	.00801	.7191	3.843	4.216	.99699
18.	284.0	.07381	540.4	11.82	.251	45.03	1.715	.00806	.7188	4.147	4.532	.99558
19.	339.4	.07337	542.0	12.15	.300	53.37	1.710	.00811	.7167	4.390	4.784	.99396
20.	392.6	.07236	543.6	12.40	.348	60.75	1.705	.00822	.7146	4.580	4.980	.99220
29.	427.8	.06638	582.3	11.94	.367	57.63	1.592	.00896	.6015	4.184	4.571	.99145
30.	350.7	.06766	580.3	11.61	.300	48.27	1.597	.00880	.6037	3.956	4.334	.99398
31.	292.5	.06830	580.5	11.28	.249	40.63	1.597	.00871	.6034	3.733	4.102	.99563
33.	236.8	.06884	580.2	10.90	.201	33.17	1.597	.00865	.6067	3.480	3.838	.99698
34.	177.2	.06927	580.0	10.38	.150	24.99	1.598	.00859	.6099	3.146	3.488	.99820
35.	120.3	.06975	578.6	9.75	.102	17.11	1.602	.00853	.6084	2.749	3.073	.99915
36.	59.2	.06978	580.0	8.64	.050	8.40	1.598	.00853	.5979	2.128	2.421	.99994
38.	118.3	.14600	555.2	11.50	.103	36.33	1.690	.00408	.6786	3.665	4.034	.99915
40.	58.4	.14562	560.7	10.09	.050	17.76	1.674	.00409	.6720	2.797	3.125	.99994
41.	174.9	.14485	559.8	12.24	.151	52.96	1.676	.00411	.6794	4.201	4.589	.99819
42.	231.1	.14364	560.4	12.86	.200	69.35	1.674	.00414	.6786	4.651	5.057	.99702
43.	290.1	.14223	561.3	13.43	.251	86.10	1.672	.00418	.6777	5.090	5.511	.99556
44.	346.0	.14053	558.9	13.99	.301	101.77	1.679	.00423	.6773	5.510	5.948	.99392
45.	385.1	.13908	561.7	14.25	.335	111.68	1.671	.00428	.6771	5.737	6.180	.99268
46.	118.0	.14309	580.3	11.18	.100	34.35	1.617	.00416	.6246	3.559	3.920	.99919
47.	60.3	.14332	579.5	9.92	.051	17.60	1.619	.00415	.6194	2.765	3.091	.99993
48.	176.9	.14240	579.8	12.02	.150	51.27	1.618	.00418	.6252	4.135	4.520	.99821
49.	236.2	.14127	580.2	12.65	.201	67.89	1.617	.00421	.6309	4.600	5.002	.99700
50.	294.1	.13991	579.7	13.22	.251	83.77	1.619	.00425	.6253	5.026	5.446	.99558
51.	114.3	.17928	540.5	11.98	.100	44.02	1.736	.00332	.7269	3.942	4.322	.99918
52.	340.3	.17300	541.5	14.91	.301	126.24	1.733	.00344	.7353	6.191	6.650	.99393
54.	284.5	.17404	540.5	14.38	.251	106.35	1.736	.00342	.7433	5.759	6.202	.99556
55.	228.0	.17552	538.5	13.74	.201	86.18	1.742	.00339	.7427	5.235	5.661	.99698
56.	170.6	.17659	539.7	12.94	.150	64.79	1.739	.00337	.7412	4.633	5.037	.99821
57.	57.1	.17790	540.2	10.65	.050	21.81	1.737	.00335	.7371	3.077	3.418	.99994
58.	57.7	.30473	539.4	11.83	.051	37.82	1.784	.00195	.7837	3.614	3.978	.99994
59.	114.3	.30379	539.8	13.42	.101	74.68	1.783	.00196	.7832	4.712	5.119	.99918
60.	171.3	.30146	540.0	14.69	.151	111.01	1.782	.00197	.7829	5.684	6.125	.99820
61.	227.6	.29895	539.7	15.68	.201	146.29	1.783	.00199	.7832	6.509	6.978	.99700
62.	284.3	.29490	542.9	16.42	.250	179.45	1.772	.00202	.7787	7.156	7.644	.99559
63.	306.1	.29325	543.6	16.69	.270	191.92	1.770	.00203	.7777	7.405	7.900	.99498
64.	305.8	.29140	561.3	16.37	.265	185.94	1.714	.00204	.7195	7.206	7.697	.99513
65.	232.3	.29457	562.0	15.37	.201	142.64	1.712	.00202	.7152	6.344	6.808	.99700
66.	173.4	.29631	560.7	14.42	.150	107.31	1.716	.00201	.7203	5.562	6.000	.99822
67.	115.6	.29740	558.7	13.17	.100	71.99	1.722	.00200	.7195	4.599	5.003	.99919
68.	58.8	.29774	558.2	11.63	.051	36.69	1.724	.00200	.7235	3.543	3.903	.99994
69.	235.5	.29452	580.9	15.14	.200	140.99	1.656	.00202	.6563	6.260	6.723	.99701
70.	294.2	.29166	582.5	15.88	.250	174.05	1.652	.00204	.6544	6.908	7.391	.99559
71.	177.5	.29619	578.2	14.24	.151	107.26	1.664	.00201	.6658	5.510	5.946	.99819
72.	119.0	.29708	578.2	13.03	.101	72.11	1.664	.00200	.6659	4.585	4.988	.99917
73.	60.0	.29708	579.1	11.42	.051	36.29	1.662	.00200	.6616	3.481	3.839	.99993
74.	236.0	.55865	581.3	17.63	.200	267.84	1.645	.00107	.6470	8.730	9.268	.99701
75.	177.1	.56108	581.4	16.63	.150	201.90	1.645	.00106	.6437	7.746	8.256	.99821
76.	119.2	.56179	580.7	15.14	.101	136.15	1.647	.00106	.6445	6.392	6.860	.99917
77.	59.8	.56091	580.2	12.94	.051	68.20	1.648	.00106	.6483	4.604	5.008	.99994
78.	58.7	.56214	562.7	13.10	.050	68.72	1.699	.00106	.7015	4.636	5.041	.99994
79.	116.8	.55853	560.5	15.39	.101	136.30	1.706	.00107	.7043	6.463	6.932	.99918
80.	174.4	.57286	561.1	16.98	.151	208.51	1.704	.00104	.7035	7.924	8.438	.99820
81.	232.5	.56698	560.9	18.05	.201	275.14	1.705	.00105	.7037	8.974	9.517	.99699
82.	57.6	.59661	541.1	13.43	.051	73.77	1.767	.00100	.7674	4.801	5.212	.99994
83.	114.6	.59209	542.1	15.74	.100	145.36	1.764	.00101	.7624	6.683	7.158	.99918
84.	171.0	.58710	541.6	17.25	.150	215.27	1.766	.00101	.7667	8.069	8.585	.99821
85.	227.8	.58093	544.3	18.26	.200	282.66	1.757	.00102	.7594	9.081	9.626	.99702
89.	57.1	.03683	540.7	7.90	.050	4.51	1.630	.01616	.6299	1.918	2.199	.99994
90.	114.7	.03691	538.5	8.81	.101	9.12	1.636	.01612	.6324	2.419	2.728	.99917
91.	170.8	.03682	539.6	9.38	.150	13.52	1.633	.01616	.6283	2.761	3.087	.99821
92.	228.0	.03664	540.5	9.81	.201	17.94	1.630	.01624	.6301	3.037	3.375	.99699
93.	283.5	.03643	540.7	10.14	.250	22.17	1.630	.01634	.6271	3.255	3.603	.99559
94.	339.0	.03615	540.7	10.43	.300	26.31	1.630	.01646	.6271	3.441	3.797	.99396
95.	393.9	.03573	541.4	10.65	.350	30.18	1.628	.01666	.6263	3.589	3.951	.99213
96.	401.0	.03562	560.5	10.49	.350	29.83	1.572	.01671	.5777	3.574	3.936	.99212
97.	344.2	.03619	560.1	10.27	.299	26.03	1.573	.01645	.5809	3.425	3.779	.99399
98.	287.5	.03659	559.8	10.02	.249	21.99	1.574	.01627	.5785	3.257	3.605	.99562
99.	232.1	.03702	559.2	9.71	.201	17.98	1.576	.01608	.5764	3.055	3.394	.99699
100.	59.5	.03672	580.2	7.62	.050	4.44	1.519	.01621	.5188	1.895	2.175	.99994
101.	118.4	.03694	580.1	8.49	.100	8.90	1.519	.01611	.5216	2.386	2.693	.99918
102.	177.8	.03703	578.5	9.09	.151	13.43	1.523	.01607	.5256	2.749	3.075	.99819
103.	236.5	.03706	577.3	9.54	.202	17.90	1.527	.01606	.5294	3.032	3.371	.99698
104.	294.4	.03682	583.5	9.81	.250	21.96	1.510	.01616	.5185	3.248	3.596	.99560
105.	349.9	.03731	582.6	10.14	.298	26.48	1.513	.01595	.5219	3.467	3.825	.99402
106.	403.5	.03705	580.8	10.39	.346	30.40	1.517	.01606	.5262	3.621	3.985	.99228
107.	173.6	.03903	558.8	9.36	.150	14.19	1.577	.01525	.5768	2.824	3.153	.99821
108.	117.2	.03927	557.0	8.80	.101	9.66	1.582	.01515	.5842	2.477	2.788	.99916
109.	59.2	.03926	561.6	7.87	.051	4.85	1.569	.01516	.5713	1.966	2.250	.99993

Wire diameter = 0.00050 inch; Wire temperature = 800 F

obs	vel	den	To	E	Mach	Re	Theta	Kn	Tau	Nu,cor	Nu"	Recovery
5.	422.7	.06780	562.4	13.82	.369	93.30	1.479	.00562	.4769	4.920	5.653	.99306
6.	401.0	.06836	560.4	13.76	.350	89.48	1.485	.00557	.4951	4.038	4.715	.99345
7.	345.0	.06908	560.9	13.42	.300	77.73	1.484	.00551	.4906	4.427	5.127	.99450
8.	288.1	.06983	560.0	13.06	.250	65.70	1.486	.00545	.4913	4.606	5.316	.99552
9.	232.8	.07183	558.1	12.65	.202	54.76	1.491	.00530	.4930	4.286	4.977	.99649
10.	173.2	.07152	560.2	11.99	.150	40.45	1.485	.00533	.4870	3.837	4.500	.99753
11.	116.4	.07165	558.9	11.23	.101	27.27	1.489	.00532	.4840	3.315	3.945	.99849
12.	58.7	.07166	558.6	10.02	.051	13.76	1.490	.00532	.4802	2.566	3.145	.99945
13.	58.1	.07437	538.4	10.30	.052	14.53	1.545	.00512	.5454	2.617	3.200	.99943
14.	113.7	.07443	538.4	11.56	.100	28.49	1.545	.00512	.5411	3.386	4.023	.99850
17.	228.2	.07432	540.2	13.02	.201	56.92	1.540	.00513	.5393	4.399	5.099	.99651
18.	284.0	.07381	540.4	13.53	.251	70.36	1.540	.00516	.5391	4.777	5.499	.99550
19.	339.4	.07337	542.0	13.91	.300	83.39	1.535	.00519	.5375	5.077	5.815	.99449
20.	392.6	.07236	543.6	14.15	.348	94.92	1.531	.00526	.5359	5.278	6.027	.99350
29.	427.8	.06638	582.3	13.41	.367	90.04	1.429	.00574	.4368	4.827	5.551	.99310
30.	350.7	.06766	580.3	13.03	.300	75.42	1.434	.00563	.4383	4.531	5.237	.99450
31.	292.5	.06830	580.5	12.64	.249	63.48	1.433	.00558	.4381	4.254	4.943	.99554
33.	236.8	.06884	580.2	12.21	.201	51.82	1.434	.00553	.4384	3.951	4.621	.99650
34.	177.2	.06927	580.0	11.62	.150	39.05	1.435	.00550	.4385	3.547	4.190	.99751
35.	120.3	.06975	578.6	10.91	.102	26.73	1.438	.00546	.4396	3.077	3.689	.99846
36.	59.2	.06978	580.0	9.65	.050	13.13	1.435	.00546	.4345	2.348	2.906	.99946
38.	118.3	.14600	555.2	12.96	.103	56.77	1.435	.00261	.4828	4.933	5.669	.99845
40.	58.4	.14562	560.7	11.35	.050	27.75	1.421	.00262	.4781	3.760	4.418	.99946
41.	174.9	.14485	559.8	13.81	.151	82.75	1.423	.00263	.4830	5.725	6.500	.99750
42.	231.1	.14364	560.4	14.59	.200	108.35	1.422	.00265	.4824	6.436	7.249	.99653
43.	290.1	.14223	561.3	15.29	.251	134.53	1.419	.00268	.4858	7.114	7.959	.99549
44.	346.0	.14053	558.9	14.85	.301	159.01	1.425	.00271	.4258	6.602	7.453	.99447
45.	385.1	.13908	561.7	15.07	.335	174.50	1.418	.00274	.4279	6.859	7.720	.99376
46.	118.0	.14309	580.3	11.44	.100	53.67	1.373	.00266	.3823	4.045	4.741	.99850
47.	60.3	.14332	579.5	10.15	.051	27.50	1.375	.00266	.3748	3.100	3.732	.99944
48.	176.9	.14240	579.8	12.36	.150	80.10	1.374	.00267	.3826	4.766	5.508	.99752
49.	236.2	.14127	580.2	13.09	.201	106.08	1.373	.00270	.3824	5.390	6.170	.99651
50.	294.1	.13991	579.7	13.74	.251	130.89	1.374	.00272	.3827	5.954	6.767	.99550
51.	114.3	.17928	540.5	12.62	.100	68.79	1.474	.00212	.4660	4.462	5.194	.99849
52.	340.3	.17300	541.5	15.95	.301	197.25	1.471	.00220	.4779	7.364	8.251	.99447
54.	284.5	.17404	540.5	15.27	.251	166.17	1.474	.00219	.4788	6.714	7.569	.99549
55.	228.0	.17552	538.5	14.61	.201	134.66	1.479	.00217	.4806	6.084	6.907	.99651
56.	170.6	.17659	539.7	13.68	.150	101.23	1.476	.00216	.4796	5.307	6.085	.99752
57.	57.1	.17790	540.2	11.14	.050	34.07	1.475	.00214	.4748	3.397	4.055	.99946
58.	57.7	.30473	539.4	12.39	.051	59.10	1.510	.00125	.5097	3.988	4.687	.99945
59.	114.3	.30379	539.8	14.14	.101	116.69	1.509	.00125	.5140	5.319	6.100	.99849
60.	171.3	.30146	540.0	15.63	.151	173.45	1.508	.00126	.5138	6.597	7.447	.99751
61.	227.6	.29895	539.7	16.58	.201	228.58	1.509	.00127	.5140	7.465	8.360	.99652
62.	284.3	.29490	542.9	17.24	.250	280.40	1.500	.00129	.5065	8.145	9.073	.99551
63.	306.1	.29325	543.6	17.49	.270	299.88	1.498	.00130	.5058	8.401	9.340	.99512
64.	305.8	.29140	561.3	17.01	.265	290.53	1.451	.00131	.4589	8.237	9.168	.99521
65.	232.3	.29457	562.0	16.03	.201	222.88	1.449	.00129	.4583	7.298	8.182	.99652
66.	173.4	.29631	560.7	15.15	.150	167.68	1.453	.00129	.4595	6.457	7.297	.99753
67.	115.6	.29740	558.7	13.79	.100	112.48	1.458	.00128	.4611	5.259	6.034	.99850
68.	58.8	.29774	558.2	12.05	.051	57.33	1.459	.00128	.4615	3.922	4.614	.99945
69.	235.5	.29452	580.9	15.62	.200	220.30	1.402	.00129	.4051	7.250	8.134	.99653
70.	294.2	.29166	582.5	16.26	.250	271.96	1.398	.00131	.4040	7.911	8.827	.99552
71.	177.5	.29619	578.2	14.77	.151	167.60	1.408	.00129	.4155	6.405	7.243	.99751
72.	119.0	.29708	578.2	13.43	.101	112.67	1.409	.00128	.4113	5.230	6.002	.99848
73.	60.0	.29708	579.1	11.67	.051	56.71	1.406	.00128	.4064	3.871	4.558	.99945
74.	236.0	.55865	581.3	18.00	.200	418.50	1.374	.00068	.3759	10.554	11.591	.99652
75.	177.1	.56108	581.4	17.00	.150	315.47	1.374	.00068	.3758	9.387	10.372	.99752
76.	119.2	.56179	580.7	15.63	.101	212.74	1.375	.00068	.3763	7.867	8.780	.99848
77.	59.8	.56091	580.2	13.30	.051	106.57	1.377	.00068	.3766	5.560	6.351	.99945
78.	58.7	.56214	562.7	13.68	.050	107.37	1.419	.00068	.4210	5.609	6.402	.99945
79.	116.8	.55853	560.5	16.11	.101	212.96	1.425	.00068	.4227	7.888	8.803	.99849
80.	174.4	.57286	561.1	17.63	.151	325.80	1.423	.00066	.4222	9.543	10.536	.99751
81.	232.5	.56698	560.9	18.68	.201	429.90	1.424	.00067	.4223	10.757	11.803	.99651
82.	57.6	.59661	541.1	14.27	.051	115.27	1.476	.00064	.4761	5.812	6.617	.99945
83.	114.6	.59209	542.1	16.69	.100	227.13	1.473	.00064	.4709	8.134	9.061	.99849
84.	171.0	.58710	541.6	18.25	.150	336.36	1.475	.00065	.4757	9.798	10.800	.99752
85.	227.8	.58093	544.3	19.30	.200	441.66	1.467	.00066	.4691	11.073	12.129	.99653
89.	57.1	.03683	540.7	8.30	.050	7.05	1.409	.01034	.4094	2.053	2.607	.99946
90.	114.7	.03691	538.5	9.33	.101	14.25	1.415	.01032	.4111	2.664	3.266	.99848
91.	170.8	.03682	539.6	9.94	.150	21.13	1.412	.01034	.4102	3.080	3.713	.99752
92.	228.0	.03664	540.5	10.41	.201	28.03	1.410	.01039	.4095	3.414	4.070	.99651
93.	283.5	.03643	540.7	10.78	.250	34.64	1.410	.01046	.4094	3.684	4.358	.99551
94.	339.0	.03615	540.7	11.10	.300	41.11	1.410	.01054	.4094	3.920	4.611	.99449
95.	393.9	.03573	541.4	11.34	.350	47.16	1.408	.01066	.4089	4.111	4.813	.99346
96.	401.0	.03562	560.5	11.03	.350	46.61	1.360	.01069	.3667	4.123	4.824	.99346
97.	344.2	.03619	560.1	10.77	.299	40.67	1.361	.01053	.3670	3.914	4.602	.99451
98.	287.5	.03659	559.8	10.50	.249	34.36	1.361	.01041	.3672	3.707	4.381	.99553
99.	232.1	.03702	559.2	10.18	.201	28.09	1.363	.01029	.3676	3.467	4.124	.99651
100.	59.5	.03672	580.2	7.76	.050	6.94	1.313	.01037	.3134	2.058	2.606	.99945
101.	118.4	.03694	580.1	8.68	.100	13.90	1.314	.01031	.3169	2.654	3.251	.99849
102.	177.8	.03703	578.5	9.34	.151	20.98	1.317	.01029	.3212	3.094	3.724	.99750
103.	236.5	.03706	577.3	9.82	.202	27.97	1.320	.01028	.3218	3.430	4.086	.99650
104.	294.4	.03682	583.5	10.06	.250	34.31	1.306	.01035	.3150	3.705	4.377	.99552
105.	349.9	.03731	582.6	10.43	.298	41.38	1.308	.01021	.3189	3.984	4.675	.99453
106.	403.5	.03705	580.8	10.72	.346	47.49	1.312	.01028	.3233	4.186	4.890	.99354
107.	173.6	.03903	558.8	9.78	.150	22.17	1.364	.00976	.3643	3.166	3.804	.99752
108.	117.2	.03927	557.0	9.18	.101	15.10	1.368	.00970	.3691	2.740	3.345	.99847
109.	59.2	.03926	561.6	8.16	.051	7.58	1.357	.00970	.3590	2.131	2.687	.99944

Table II.2 Raw data along with other quantities of interest for parallel wire probe

Wire diameter = 0.00015 inch; Wire temperature = 990 F

obs	vel	den	To	E	Mach	Re	Theta	Kn	Tau	Nu,cor	Nu"	Recovery
5.	422.7	.06780	562.4	6.90	.369	27.99	1.752	.01873	.7675	4.150	4.564	.98483
6.	401.0	.06836	560.4	6.86	.350	26.84	1.759	.01857	.7686	4.103	4.519	.99020
7.	345.0	.06908	560.9	6.71	.300	23.32	1.757	.01838	.7645	3.923	4.337	.99275
8.	288.1	.06983	560.0	6.54	.250	19.71	1.760	.01818	.7656	3.714	4.124	.99423
9.	232.8	.07183	558.1	6.35	.202	16.43	1.766	.01768	.7666	3.481	3.887	.99949
10.	173.2	.07152	560.2	6.04	.150	12.14	1.759	.01775	.7550	3.130	3.532	1.00431
11.	116.4	.07165	558.9	5.68	.101	8.18	1.763	.01772	.7602	2.735	3.126	1.00310
12.	58.7	.07166	558.6	5.11	.051	4.13	1.764	.01772	.7538	2.152	2.531	1.01069
13.	58.1	.07437	538.4	5.24	.052	4.36	1.831	.01707	.8305	2.329	2.621	1.00000
14.	113.7	.07443	538.4	5.81	.100	8.55	1.830	.01706	.8251	2.848	3.226	1.00534
17.	228.2	.07432	540.2	6.49	.201	17.08	1.825	.01708	.8260	3.618	4.013	.99852
18.	284.0	.07381	540.4	6.71	.251	21.11	1.824	.01720	.8257	3.890	4.290	.99816
19.	339.4	.07337	542.0	6.89	.300	25.02	1.819	.01730	.8233	4.109	4.512	.99523
20.	392.6	.07236	543.6	7.02	.348	28.48	1.813	.01754	.8208	4.277	4.683	.99224
29.	427.8	.06638	582.3	6.75	.367	27.01	1.692	.01913	.6981	3.962	4.437	.99439
30.	350.7	.06766	580.3	6.59	.300	22.63	1.699	.01877	.7039	3.810	4.239	.99460
31.	292.5	.06830	580.5	6.41	.249	19.04	1.698	.01859	.7052	3.606	4.027	.99246
33.	236.8	.06884	580.2	6.21	.201	15.55	1.699	.01844	.7073	3.375	3.789	.99135
34.	177.2	.06927	580.0	5.94	.150	11.71	1.699	.01833	.7059	3.060	3.466	.99339
35.	120.3	.06975	578.6	5.59	.102	8.02	1.703	.01820	.7009	2.679	3.078	1.00253
36.	59.2	.06978	580.0	5.01	.050	3.94	1.699	.01819	.6992	2.090	2.470	1.00000
38.	118.3	.14600	555.2	6.57	.103	17.03	1.727	.00870	.7208	4.017	4.443	1.00594
40.	58.4	.14562	560.7	5.82	.050	8.33	1.710	.00872	.7153	3.107	3.507	.99440
41.	174.9	.14485	559.8	6.98	.151	24.83	1.713	.00877	.7197	4.602	5.035	.99277
42.	231.1	.14364	560.4	7.30	.200	32.51	1.710	.00884	.7189	5.053	5.496	.99158
43.	290.1	.14223	561.3	7.55	.251	40.36	1.708	.00893	.7178	5.388	5.875	.99015
44.	346.0	.14053	558.9	7.74	.301	47.70	1.715	.00903	.7143	5.661	6.145	1.00078
45.	385.1	.13908	561.7	7.87	.335	52.35	1.707	.00913	.7140	5.863	6.346	.99266
46.	118.0	.14309	580.3	6.36	.100	16.10	1.652	.00887	.6596	3.837	4.270	.99222
47.	60.3	.14332	579.5	5.69	.051	8.25	1.654	.00886	.6543	3.001	3.413	1.00000
48.	176.9	.14240	579.8	6.82	.150	24.03	1.653	.00892	.6618	4.433	4.901	.99153
49.	236.2	.14127	580.2	7.17	.201	31.82	1.652	.00899	.6645	4.931	5.401	.98780
50.	294.1	.13991	579.7	7.44	.251	39.27	1.654	.00907	.6666	5.321	5.795	.98699
51.	114.3	.17928	540.5	6.77	.100	20.64	1.774	.00708	.7657	4.238	4.656	1.00797
52.	340.3	.17300	541.5	8.20	.301	59.18	1.770	.00734	.7743	6.346	6.793	.99584
54.	284.5	.17404	540.5	7.98	.251	49.85	1.773	.00729	.7775	6.021	6.461	.99600
55.	228.0	.17552	538.5	7.72	.201	40.40	1.780	.00723	.7803	5.617	6.051	.99969
56.	170.6	.17659	539.7	7.35	.150	30.37	1.776	.00719	.7770	5.069	5.494	.99929
57.	57.1	.17790	540.2	6.12	.050	10.22	1.775	.00714	.7746	3.417	3.812	1.00000
58.	57.7	.30473	539.4	6.78	.051	17.73	1.887	.00417	.8874	3.693	4.093	1.00000
59.	114.3	.30379	539.8	7.59	.101	35.01	1.886	.00418	.8869	4.721	5.140	.99938
60.	171.3	.30146	540.0	8.17	.151	52.03	1.886	.00421	.8865	5.511	5.945	.99898
61.	227.6	.29895	539.7	8.59	.201	68.57	1.886	.00425	.8869	6.111	6.555	.99942
62.	284.3	.29490	542.9	8.95	.250	84.12	1.875	.00431	.8799	6.662	7.117	.99559
63.	306.1	.29325	543.6	9.08	.270	89.96	1.873	.00433	.8788	6.861	7.319	.99432
64.	305.8	.29140	561.3	8.93	.265	87.16	1.814	.00436	.8194	6.659	7.147	.99445
65.	232.3	.29457	562.0	8.45	.201	66.86	1.812	.00431	.8165	5.931	6.414	.99503
66.	173.4	.29631	560.7	8.04	.150	50.30	1.816	.00428	.8203	5.315	5.807	.99561
67.	115.6	.29740	558.7	7.50	.100	33.74	1.822	.00427	.8214	4.623	5.059	1.00098
68.	58.8	.29774	558.2	6.67	.051	17.20	1.824	.00426	.8240	3.599	4.010	1.00002
69.	235.5	.29452	580.9	8.35	.200	66.09	1.753	.00431	.7559	5.850	6.335	.99687
70.	294.2	.29166	582.5	8.68	.250	81.59	1.748	.00435	.7538	6.351	6.845	.99407
71.	177.5	.29619	578.2	7.94	.151	50.28	1.761	.00429	.7666	5.257	5.730	.99421
72.	119.0	.29708	578.2	7.41	.101	33.80	1.761	.00427	.7648	4.522	4.992	.99611
73.	60.0	.29708	579.1	6.57	.051	17.01	1.758	.00427	.7583	3.510	3.931	1.00000
74.	236.0	.55865	581.3	9.70	.200	125.55	1.726	.00227	.7260	8.322	8.861	.99967
75.	177.1	.56108	581.4	9.11	.150	94.64	1.726	.00226	.7277	7.310	7.825	.99785
76.	119.2	.56179	580.7	8.39	.101	63.82	1.728	.00226	.7286	6.139	6.629	.99911
77.	59.8	.56091	580.2	7.40	.051	31.97	1.729	.00226	.7293	4.699	5.168	1.00000
78.	58.7	.56214	562.7	7.51	.050	32.21	1.783	.00226	.7840	4.818	5.256	.99895
79.	116.8	.55853	560.5	8.51	.101	63.89	1.790	.00227	.7888	6.247	6.732	1.00111
80.	174.4	.57286	561.1	9.31	.151	97.74	1.788	.00222	.7880	7.554	8.055	1.00004
81.	232.5	.56698	560.9	9.92	.201	128.97	1.788	.00224	.7900	8.617	9.133	.99849
82.	57.6	.59661	541.1	7.69	.051	34.58	1.854	.00213	.8542	5.034	5.454	1.00000
83.	114.6	.59209	542.1	8.71	.100	68.14	1.850	.00214	.8488	6.536	6.986	1.00167
84.	171.0	.58710	541.6	9.50	.150	100.91	1.852	.00216	.8516	7.809	8.310	1.00090
85.	227.8	.58093	544.3	10.10	.200	132.50	1.843	.00219	.8436	8.884	9.388	.99957
89.	57.1	.03683	540.7	4.58	.050	2.11	1.839	.03447	.8389	1.740	1.971	1.00000
90.	114.7	.03691	538.5	5.05	.101	4.28	1.846	.03440	.8460	2.124	2.396	1.00036
91.	170.8	.03682	539.6	5.35	.150	6.34	1.843	.03448	.8424	2.370	2.679	1.00015
92.	228.0	.03664	540.5	5.57	.201	8.41	1.840	.03465	.8410	2.569	2.904	.99849
93.	283.5	.03643	540.7	5.74	.250	10.39	1.839	.03485	.8408	2.727	3.083	.99826
94.	339.0	.03615	540.7	5.89	.300	12.33	1.839	.03512	.8408	2.860	3.233	.99827
95.	393.9	.03573	541.4	6.00	.350	14.15	1.837	.03554	.8415	2.970	3.350	.99509
96.	401.0	.03562	560.5	5.92	.350	13.98	1.774	.03564	.7810	2.906	3.296	.99284
97.	344.2	.03619	560.1	5.80	.299	12.20	1.775	.03509	.7816	2.789	3.176	.99357
98.	287.5	.03659	559.8	5.67	.249	10.31	1.776	.03470	.7803	2.658	3.043	.99589
99.	232.1	.03702	559.2	5.51	.201	8.43	1.778	.03430	.7811	2.498	2.880	.99697
100.	59.5	.03672	580.2	4.43	.050	2.08	1.714	.03458	.7136	1.538	1.899	1.00000
101.	118.4	.03694	580.1	4.88	.100	4.17	1.714	.03437	.7121	1.921	2.296	1.00193
102.	177.8	.03703	578.5	5.20	.151	6.29	1.719	.03428	.7192	2.219	2.602	.99961
103.	236.5	.03706	577.3	5.43	.202	8.39	1.722	.03426	.7190	2.442	2.834	1.00344
104.	294.4	.03682	583.5	5.56	.250	10.29	1.704	.03449	.7164	2.593	2.983	.98759
105.	349.9	.03731	582.6	5.74	.298	12.41	1.707	.03402	.7073	2.760	3.161	.99929
106.	403.5	.03705	580.8	5.87	.346	14.25	1.712	.03427	.7164	2.888	3.290	.99571
107.	173.6	.03903	558.8	5.34	.150	6.65	1.779	.03253	.7782	2.320	2.700	1.00124
108.	117.2	.03927	557.0	5.05	.101	4.53	1.785	.03233	.7843	2.054	2.416	1.00098
109.	59.2	.03926	561.6	4.57	.051	2.27	1.771	.03234	.7691	1.670	1.987	1.00161

Wire diameter = 0.00032 inch; Wire temperature = 928 F

obs	vel	den	To	E	Mach	Re	Theta	Kn	Tau	Nu,cor	Nu"	Recovery
5.	422.7	.06780	562.4	12.51	.369	59.71	1.629	.00878	.6448	4.373	5.716	.98372
6.	401.0	.06836	560.4	12.43	.350	57.27	1.635	.00871	.6472	4.298	5.640	.98736
7.	345.0	.06908	560.9	12.15	.300	49.75	1.633	.00862	.6413	4.068	5.405	.99176
8.	288.1	.06983	560.0	11.83	.250	42.05	1.636	.00852	.6423	3.802	5.128	.99324
9.	232.8	.07183	558.1	11.47	.202	35.04	1.641	.00829	.6392	3.503	4.814	1.00209
10.	173.2	.07152	560.2	10.93	.150	25.89	1.635	.00832	.6315	3.168	4.392	1.00357
11.	116.4	.07165	558.9	10.30	.101	17.45	1.639	.00831	.6382	2.838	3.902	1.00050
12.	58.7	.07166	558.6	9.28	.051	8.81	1.640	.00831	.6280	2.269	3.173	1.01180
13.	58.1	.07437	538.4	9.51	.052	9.30	1.701	.00800	.7012	2.511	3.263	1.00000
14.	113.7	.07443	538.4	10.55	.100	18.23	1.701	.00800	.7012	3.083	4.005	.99994
17.	228.2	.07432	540.2	11.76	.201	36.43	1.696	.00801	.6989	3.820	4.963	.99673
18.	284.0	.07381	540.4	12.17	.251	45.03	1.695	.00806	.6987	4.089	5.313	.99637
19.	339.4	.07337	542.0	12.49	.300	53.37	1.690	.00811	.6966	4.307	5.595	.99345
20.	392.6	.07236	543.6	12.67	.348	60.75	1.685	.00822	.6945	4.430	5.755	.99046
29.	427.8	.06638	582.3	12.14	.367	57.63	1.573	.00896	.5718	4.157	5.512	1.00116
30.	350.7	.06766	580.3	11.83	.300	48.27	1.579	.00880	.5738	3.900	5.245	1.00473
31.	292.5	.06830	580.5	11.51	.249	40.63	1.578	.00871	.5838	3.659	4.979	.99401
33.	236.8	.06884	580.2	11.15	.201	33.17	1.579	.00865	.5841	3.374	4.680	.99457
34.	177.2	.06927	580.0	10.65	.150	24.99	1.579	.00859	.5843	2.998	4.284	.99494
35.	120.3	.06975	578.6	10.06	.102	17.11	1.583	.00853	.5806	2.615	3.817	1.00253
36.	59.2	.06978	580.0	9.00	.050	8.40	1.579	.00853	.5791	2.104	3.072	1.00000
38.	118.3	.14600	555.2	11.76	.103	36.33	1.764	.00408	.7655	3.105	4.304	.99876
40.	58.4	.14562	560.7	10.39	.050	17.76	1.747	.00409	.7580	2.441	3.384	.98892
41.	174.9	.14485	559.8	12.43	.151	52.96	1.750	.00411	.7592	3.504	4.827	.99055
42.	231.1	.14364	560.4	13.07	.200	69.35	1.748	.00414	.7647	3.988	5.328	.98298
43.	290.1	.14223	561.3	13.64	.251	86.10	1.745	.00418	.7636	4.433	5.792	.98156
44.	346.0	.14053	558.9	14.17	.301	101.77	1.752	.00423	.7603	4.844	6.233	.99201
45.	385.1	.13908	561.7	14.44	.335	111.68	1.744	.00428	.7630	5.087	6.475	.98083
46.	118.0	.14309	580.3	11.36	.100	34.35	1.688	.00416	.6954	2.826	4.105	.99236
47.	60.3	.14332	579.5	10.19	.051	17.60	1.690	.00415	.6902	2.244	3.306	1.00000
48.	176.9	.14240	579.8	12.17	.150	51.27	1.689	.00418	.6960	3.391	4.703	.99325
49.	236.2	.14127	580.2	12.81	.201	67.89	1.688	.00421	.6956	3.862	5.198	.99267
50.	294.1	.13991	579.7	13.39	.251	83.77	1.690	.00425	.6961	4.308	5.669	.99343
51.	114.3	.17928	540.5	12.15	.100	44.02	1.812	.00332	.8062	3.368	4.555	1.00613
52.	340.3	.17300	541.5	14.99	.301	126.24	1.809	.00344	.8111	5.474	6.897	.99752
54.	284.5	.17404	540.5	14.50	.251	106.35	1.812	.00342	.8193	5.066	6.467	.99277
55.	228.0	.17552	538.5	13.92	.201	86.18	1.819	.00339	.8223	4.574	5.958	.99645
56.	170.6	.17659	539.7	13.08	.150	64.79	1.815	.00337	.8206	3.964	5.274	.99437
57.	57.1	.17790	540.2	10.89	.050	21.81	1.813	.00335	.8132	2.733	3.666	1.00000
58.	57.7	.30473	539.4	12.00	.051	37.82	1.602	.00195	.6024	4.634	6.025	1.00000
59.	114.3	.30379	539.8	13.58	.101	74.68	1.601	.00196	.6070	6.255	7.706	.99449
60.	171.3	.30146	540.0	14.80	.151	111.01	1.601	.00197	.6018	7.617	9.133	.99898
61.	227.6	.29895	539.7	15.75	.201	146.29	1.602	.00199	.6070	8.771	10.323	.99453
62.	284.3	.29490	542.9	16.29	.250	179.45	1.592	.00202	.6035	9.487	11.061	.98880
63.	306.1	.29325	543.6	16.48	.270	191.92	1.590	.00203	.5930	9.731	11.334	.99726
64.	305.8	.29140	561.3	16.11	.265	185.94	1.540	.00204	.5460	9.495	11.119	.99395
65.	232.3	.29457	562.0	15.16	.201	142.64	1.538	.00202	.5359	8.252	9.884	1.00208
66.	173.4	.29631	560.7	14.26	.150	107.31	1.542	.00201	.5372	7.208	8.742	1.00453
67.	115.6	.29740	558.7	13.09	.100	71.99	1.547	.00200	.5344	5.881	7.361	1.01281
68.	58.8	.29774	558.2	11.57	.051	36.69	1.549	.00200	.5349	4.364	5.767	1.01372
69.	235.5	.29452	580.9	14.92	.200	140.99	1.488	.00202	.4867	8.314	9.886	1.00142
70.	294.2	.29166	582.5	15.58	.250	174.05	1.484	.00204	.4899	9.203	10.791	.99407
71.	177.5	.29619	578.2	14.06	.151	107.26	1.495	.00201	.4980	7.184	8.767	.99686
72.	119.0	.29708	578.2	12.89	.101	72.11	1.495	.00200	.4981	5.910	7.385	.99695
73.	60.0	.29708	579.1	11.35	.051	36.29	1.493	.00200	.4928	4.360	5.754	1.00000
74.	236.0	.55865	581.3	17.28	.200	267.84	1.724	.00107	.7264	7.363	8.955	.99794
75.	177.1	.56108	581.4	16.29	.150	201.90	1.724	.00106	.7330	6.476	7.976	.99113
76.	119.2	.56179	580.7	14.97	.101	136.15	1.726	.00106	.7340	5.298	6.735	.99238
77.	59.8	.56091	580.2	12.82	.051	68.20	1.728	.00106	.7279	3.601	4.949	1.00000
78.	58.7	.56214	562.7	13.05	.050	68.72	1.781	.00106	.7921	3.707	5.061	.98932
79.	116.8	.55853	560.5	15.22	.101	136.30	1.789	.00107	.7953	5.419	6.865	.99324
80.	174.4	.57286	561.1	16.70	.151	208.51	1.787	.00104	.7944	6.744	8.255	.99218
81.	232.5	.56698	560.9	17.71	.201	275.14	1.787	.00105	.7946	7.720	9.278	.99241
82.	57.6	.59661	541.1	13.33	.051	73.77	1.853	.00100	.8527	3.847	5.227	1.00000
83.	114.6	.59209	542.1	15.51	.100	145.36	1.849	.00101	.8510	5.613	7.077	.99797
84.	171.0	.58710	541.6	16.89	.150	215.27	1.851	.00101	.8519	6.853	8.375	.99905
85.	227.8	.58093	544.3	17.92	.200	282.66	1.842	.00102	.8549	7.876	9.430	.98686
89.	57.1	.03683	540.7	8.10	.050	4.51	1.658	.01616	.6580	1.776	2.505	1.00000
90.	114.7	.03691	538.5	8.95	.101	9.12	1.665	.01612	.6606	2.159	3.045	1.00403
91.	170.8	.03682	539.6	9.47	.150	13.52	1.661	.01616	.6593	2.418	3.410	1.00198
92.	228.0	.03664	540.5	9.87	.201	17.94	1.659	.01624	.6582	2.624	3.700	1.00032
93.	283.5	.03643	540.7	10.19	.250	22.17	1.658	.01634	.6580	2.787	3.931	1.00009
94.	339.0	.03615	540.7	10.46	.300	26.31	1.658	.01646	.6580	2.932	4.135	1.00010
95.	393.9	.03573	541.4	10.67	.350	30.18	1.656	.01666	.6628	3.074	4.298	.99312
96.	401.0	.03562	560.5	10.48	.350	29.83	1.599	.01671	.6076	2.920	4.244	.99176
97.	344.2	.03619	560.1	10.27	.299	26.03	1.601	.01645	.6080	2.770	4.078	.99248
98.	287.5	.03659	559.8	10.04	.249	21.99	1.601	.01627	.6084	2.652	3.906	.99304
99.	232.1	.03702	559.2	9.76	.201	17.98	1.603	.01608	.6090	2.511	3.699	.99412
100.	59.5	.03672	580.2	7.77	.050	4.44	1.545	.01621	.5450	1.536	2.437	1.00000
101.	118.4	.03694	580.1	8.57	.100	8.90	1.545	.01611	.5451	1.863	2.955	1.00022
102.	177.8	.03703	578.5	9.16	.151	13.43	1.550	.01607	.5572	2.157	3.357	.99252
103.	236.5	.03706	577.3	9.60	.202	17.90	1.553	.01606	.5584	2.385	3.673	.99461
104.	294.4	.03682	583.5	9.80	.250	21.96	1.536	.01616	.5576	2.567	3.851	.97873
105.	349.9	.03731	582.6	10.13	.298	26.48	1.539	.01595	.5480	2.795	4.104	.99068
106.	403.5	.03705	580.8	10.39	.346	30.40	1.544	.01606	.5602	2.972	4.286	.98340
107.	173.6	.03903	558.8	9.47	.150	14.19	1.604	.01525	.6149	2.389	3.489	.98940
108.	117.2	.03927	557.0	8.96	.101	9.66	1.610	.01515	.6279	2.176	3.122	.98173
109.	59.2	.03926	561.6	8.09	.051	4.85	1.596	.01516	.6119	1.758	2.567	.98455

Table II.2 2 of 3

Wire diameter = 0.00050 inch; Wire temperature = 814 F

obs	vel	den	To	E	Mach	Re	Theta	Kn	Tau	Nu,cor	Nu"	Recovery
5.	422.7	.06780	562.4	13.51	.369	93.30	1.475	.00562	.4884	4.502	7.026	.98689
6.	401.0	.06836	560.4	13.36	.350	89.48	1.481	.00557	.4605	4.125	6.853	1.02025
7.	345.0	.06908	560.9	13.00	.300	77.73	1.479	.00551	.4823	4.114	6.519	.99706
8.	288.1	.06983	560.0	12.63	.250	65.70	1.482	.00545	.4830	3.881	6.151	.99855
9.	232.8	.07183	558.1	12.24	.202	54.76	1.487	.00530	.4848	3.636	5.762	1.00209
10.	173.2	.07152	560.2	11.66	.150	40.45	1.481	.00533	.4755	3.275	5.271	1.00569
11.	116.4	.07165	558.9	10.99	.101	27.27	1.484	.00532	.4765	2.908	4.679	1.00795
12.	58.7	.07166	558.6	9.92	.051	13.76	1.485	.00532	.4694	2.328	3.807	1.01606
13.	58.1	.07437	538.4	10.26	.052	14.53	1.541	.00512	.5411	2.667	3.925	1.00000
14.	113.7	.07443	538.4	11.39	.100	28.49	1.541	.00512	.5411	3.280	4.827	.99994
17.	228.2	.07432	540.2	12.70	.201	56.92	1.536	.00513	.5393	4.075	5.997	.99673
18.	284.0	.07381	540.4	13.17	.251	70.36	1.535	.00516	.5391	4.376	6.439	.99637
19.	339.4	.07337	542.0	13.50	.300	83.39	1.531	.00519	.5375	4.608	6.781	.99345
20.	392.6	.07236	543.6	13.82	.348	94.92	1.526	.00526	.5359	4.833	7.111	.99046
29.	427.8	.06638	582.3	12.83	.367	90.04	1.425	.00574	.4288	3.855	6.617	.99605
30.	350.7	.06766	580.3	12.45	.300	75.42	1.430	.00563	.4303	3.634	6.238	.99961
31.	292.5	.06830	580.5	12.11	.249	63.48	1.429	.00558	.4301	3.448	5.919	.99913
33.	236.8	.06884	580.2	11.70	.201	51.82	1.430	.00553	.4376	3.281	5.540	.99252
34.	177.2	.06927	580.0	11.18	.150	39.05	1.431	.00550	.4305	2.954	5.071	1.00007
35.	120.3	.06975	578.6	10.58	.102	26.73	1.434	.00546	.4316	2.637	4.528	1.00253
36.	59.2	.06978	580.0	9.47	.050	13.13	1.431	.00546	.4305	2.123	3.645	1.00000
38.	118.3	.14600	555.2	12.56	.103	56.77	1.468	.00261	.4599	4.033	6.391	1.00841
40.	58.4	.14562	560.7	11.07	.050	27.75	1.454	.00262	.4554	3.179	5.038	.99848
41.	174.9	.14485	559.8	13.25	.151	82.75	1.456	.00263	.4562	4.536	7.188	1.00011
42.	231.1	.14364	560.4	13.96	.200	108.35	1.455	.00265	.4556	5.031	7.972	.99891
43.	290.1	.14223	561.3	14.61	.251	134.53	1.452	.00268	.4549	5.504	8.722	.99747
44.	346.0	.14053	558.9	15.27	.301	159.01	1.458	.00271	.4568	5.964	9.450	1.00160
45.	385.1	.13908	561.7	15.48	.335	174.50	1.451	.00274	.4616	6.252	9.756	.98974
46.	118.0	.14309	580.3	11.90	.100	53.67	1.405	.00266	.4061	3.560	6.111	.99852
47.	60.3	.14332	579.5	10.70	.051	27.50	1.407	.00266	.4067	2.873	4.932	1.00000
48.	176.9	.14240	579.8	12.81	.150	80.10	1.406	.00267	.4133	4.178	7.054	.99263
49.	236.2	.14127	580.2	13.54	.201	106.08	1.405	.00270	.4130	4.662	7.872	.99205
50.	294.1	.13991	579.7	14.19	.251	130.89	1.406	.00272	.4134	5.096	8.604	.99282
51.	114.3	.17928	540.5	13.10	.100	68.79	1.508	.00212	.4943	4.451	6.742	1.01405
52.	340.3	.17300	541.5	16.34	.301	197.25	1.505	.00220	.5078	7.090	10.433	.99752
54.	284.5	.17404	540.5	15.81	.251	166.17	1.508	.00219	.5160	6.750	9.792	.99211
55.	228.0	.17552	538.5	15.12	.201	134.66	1.514	.00217	.5106	6.071	8.934	1.00308
56.	170.6	.17659	539.7	14.20	.150	101.23	1.511	.00216	.5095	5.378	7.913	1.00098
57.	57.1	.17790	540.2	11.74	.050	34.07	1.509	.00214	.5090	3.689	5.428	1.00000
58.	57.7	.30473	539.4	12.95	.051	59.10	1.514	.00125	.5143	4.455	6.556	1.00000
59.	114.3	.30379	539.8	14.72	.101	116.69	1.513	.00125	.5140	5.748	8.458	.99938
60.	171.3	.30146	540.0	16.09	.151	173.45	1.513	.00126	.5138	6.870	10.109	.99898
61.	227.6	.29895	539.7	17.10	.201	228.58	1.513	.00127	.5213	7.853	11.393	.99208
62.	284.3	.29490	542.9	17.66	.250	280.40	1.505	.00129	.5110	8.290	12.198	.99367
63.	306.1	.29325	543.6	17.89	.270	299.88	1.503	.00130	.5104	8.510	12.522	.99240
64.	305.8	.29140	561.3	17.36	.265	290.53	1.455	.00131	.4660	7.839	12.233	.98924
65.	232.3	.29457	562.0	16.39	.201	222.88	1.453	.00129	.4583	6.908	10.946	.99503
66.	173.4	.29631	560.7	15.49	.150	167.68	1.457	.00129	.4665	6.265	9.776	.99040
67.	115.6	.29740	558.7	14.23	.100	112.48	1.462	.00128	.4611	5.195	8.232	1.00098
68.	58.8	.29774	558.2	12.56	.051	57.33	1.463	.00128	.4615	4.045	6.410	1.00189
69.	235.5	.29452	580.9	15.96	.200	220.30	1.406	.00129	.4094	6.334	10.872	.99687
70.	294.2	.29166	582.5	16.71	.250	271.96	1.402	.00131	.4082	7.083	11.927	.99407
71.	177.5	.29619	578.2	15.16	.151	167.60	1.413	.00129	.4181	5.789	9.774	.99457
72.	119.0	.29708	578.2	13.90	.101	112.67	1.413	.00128	.4181	4.876	8.234	.99466
73.	60.0	.29708	579.1	12.21	.051	56.71	1.411	.00128	.4106	3.712	6.371	1.00000
74.	236.0	.55865	581.3	18.43	.200	418.50	1.401	.00068	.4035	9.608	14.646	.99794
75.	177.1	.56108	581.4	17.46	.150	315.47	1.401	.00068	.4035	8.240	13.177	.99785
76.	119.2	.56179	580.7	16.04	.101	212.74	1.403	.00068	.4040	6.471	11.107	.99911
77.	59.8	.56091	580.2	13.79	.051	106.57	1.404	.00068	.4044	4.791	8.224	1.00000
78.	58.7	.56214	562.7	14.19	.050	107.37	1.448	.00068	.4517	5.257	8.330	.99627
79.	116.8	.55853	560.5	16.55	.101	212.96	1.454	.00068	.4535	7.106	11.259	1.00022
80.	174.4	.57286	561.1	18.10	.151	325.80	1.452	.00066	.4530	8.503	13.459	.99915
81.	232.5	.56698	560.9	19.16	.201	429.90	1.452	.00067	.4531	9.985	15.060	.99938
82.	57.6	.59661	541.1	14.74	.051	115.27	1.506	.00064	.5059	5.837	8.588	1.00000
83.	114.6	.59209	542.1	17.09	.100	227.13	1.503	.00064	.5048	7.860	11.565	.99797
84.	171.0	.58710	541.6	18.59	.150	336.36	1.504	.00065	.5054	9.275	13.648	.99905
85.	227.8	.58093	544.3	19.54	.200	441.66	1.497	.00066	.5029	10.286	15.134	.99405
89.	57.1	.03683	540.7	9.05	.050	7.05	1.465	.01034	.4652	2.396	3.526	1.00000
90.	114.7	.03691	538.5	10.01	.101	14.25	1.471	.01032	.4671	2.911	4.283	1.00403
91.	170.8	.03682	539.6	10.58	.150	21.13	1.468	.01034	.4662	3.259	4.795	1.00198
92.	228.0	.03664	540.5	11.02	.201	28.03	1.466	.01039	.4654	3.537	5.204	1.00032
93.	283.5	.03643	540.7	11.35	.250	34.64	1.465	.01046	.4653	3.745	5.510	1.00009
94.	339.0	.03615	540.7	11.67	.300	41.11	1.465	.01054	.4653	3.946	5.806	1.00010
95.	393.9	.03573	541.4	11.90	.350	47.16	1.463	.01066	.4713	4.159	6.033	.99210
96.	401.0	.03562	560.5	11.56	.350	46.61	1.413	.01069	.4167	3.757	5.953	.99669
97.	344.2	.03619	560.1	11.33	.299	40.67	1.414	.01053	.4234	3.674	5.734	.99100
98.	287.5	.03659	559.8	11.08	.249	34.36	1.415	.01041	.4237	3.524	5.500	.99155
99.	232.1	.03702	559.2	10.78	.201	28.09	1.417	.01029	.4241	3.340	5.213	.99263
100.	59.5	.03672	580.2	8.48	.050	6.94	1.365	.01037	.3654	1.975	3.447	1.00000
101.	118.4	.03694	580.1	9.33	.100	13.90	1.366	.01031	.3655	2.390	4.172	1.00022
102.	177.8	.03703	578.5	9.97	.151	20.98	1.370	.01029	.3727	2.754	4.728	.99682
103.	236.5	.03706	577.3	10.47	.202	27.97	1.372	.01028	.3735	3.014	5.174	.99892
104.	294.4	.03682	583.5	10.61	.250	34.31	1.358	.01035	.3634	3.098	5.408	.99437
105.	349.9	.03731	582.6	10.98	.298	41.38	1.360	.01021	.3639	3.293	5.749	.99590
106.	403.5	.03705	580.8	11.27	.346	47.49	1.364	.01028	.3713	3.495	6.000	.99292
107.	173.6	.03903	558.8	10.40	.150	22.17	1.418	.00976	.4180	3.062	4.853	.99979
108.	117.2	.03927	557.0	9.86	.101	15.10	1.422	.00970	.4258	2.787	4.349	.99662
109.	59.2	.03926	561.6	8.89	.051	7.58	1.411	.00970	.4096	2.227	3.584	1.00129

Table II.2 3 of 3

Table II.3 Raw data along with other quantities of interest for single wire probe

Wire diameter = 0.00015 inch; Wire temperature = 1050 F

obs	vel	den	To	E	Mach	Re	Theta	Kn	Tau	Nu,cor	Nu"	Recovery
38.	118.3	.14600	555.2	6.45	.103	17.03	1.927	.00870	.9179	2.857	3.166	1.00942
39.	118.3	.14567	559.1	6.43	.102	16.91	1.914	.00872	.9113	2.841	3.148	1.00224
40.	58.4	.14562	560.7	5.72	.050	8.33	1.908	.00872	.9088	2.217	2.494	.99948
41.	174.9	.14485	559.8	6.84	.151	24.83	1.911	.00877	.9163	3.247	3.570	.99510
42.	231.1	.14364	560.4	7.16	.200	32.51	1.909	.00884	.9152	3.568	3.904	.99391
43.	290.1	.14223	561.3	7.42	.251	40.36	1.906	.00893	.9159	3.844	4.190	.99047
44.	346.0	.14053	558.9	7.64	.301	47.70	1.914	.00903	.9137	4.073	4.429	1.00059
45.	385.1	.13908	561.7	7.74	.335	52.35	1.905	.00913	.9132	4.187	4.546	.99173
46.	118.0	.14309	580.3	6.31	.100	16.10	1.844	.00887	.8510	2.766	3.068	.99271
47.	60.3	.14332	579.5	5.65	.051	8.25	1.846	.00886	.8464	2.181	2.456	1.00000
48.	176.9	.14240	579.8	6.75	.150	24.03	1.845	.00892	.8517	3.186	3.505	.99360
49.	236.2	.14127	580.2	7.08	.201	31.82	1.844	.00899	.8532	3.517	3.850	.99109
50.	294.1	.13991	579.7	7.33	.251	39.27	1.846	.00907	.8538	3.781	4.125	.99185
51.	114.3	.17928	540.5	6.68	.100	20.64	1.980	.00708	.9719	3.062	3.379	1.00782
52.	340.3	.17300	541.5	7.98	.301	59.18	1.976	.00734	.9741	4.444	4.813	1.00167
54.	284.5	.17404	540.5	7.78	.251	49.85	1.979	.00729	.9863	4.219	4.579	.99315
55.	228.0	.17552	538.5	7.53	.201	40.40	1.987	.00723	.9900	3.936	4.286	.99683
56.	170.6	.17659	539.7	7.17	.150	30.37	1.983	.00719	.9858	3.556	3.892	.99682
57.	57.1	.17790	540.2	5.97	.050	10.22	1.981	.00714	.9807	2.420	2.707	1.00000
58.	57.7	.30473	539.4	6.62	.051	17.73	2.022	.00417	1.0221	2.890	3.198	1.00000
59.	114.3	.30379	539.8	7.44	.101	35.01	2.021	.00418	1.0236	3.696	4.037	.99722
60.	171.3	.30146	540.0	7.97	.151	52.03	2.020	.00421	1.0210	4.270	4.632	.99898
61.	227.6	.29895	539.7	8.38	.201	68.57	2.021	.00425	1.0215	4.739	5.118	.99942
62.	284.3	.29490	542.9	8.72	.250	84.12	2.009	.00431	1.0135	5.140	5.532	.99582
63.	306.1	.29325	543.6	8.85	.270	89.96	2.007	.00433	1.0122	5.302	5.699	.99455
64.	305.8	.29140	561.3	8.75	.265	87.16	1.943	.00436	.9490	5.198	5.592	.99423
65.	232.3	.29457	562.0	8.28	.201	66.86	1.941	.00431	.9457	4.641	5.016	.99503
66.	173.4	.29631	560.7	7.87	.150	50.30	1.945	.00428	.9501	4.177	4.536	.99539
67.	115.6	.29740	558.7	7.34	.100	33.74	1.952	.00427	.9514	3.611	3.949	1.00098
68.	58.8	.29774	558.2	6.53	.051	17.20	1.954	.00426	.9501	2.823	3.128	1.00398
69.	235.5	.29452	580.9	8.20	.200	66.09	1.878	.00431	.8829	4.589	4.962	.99487
70.	294.2	.29166	582.5	8.57	.250	81.59	1.873	.00435	.8785	5.019	5.407	.99407
71.	177.5	.29619	578.2	7.81	.151	50.28	1.886	.00429	.8910	4.144	4.501	.99538
72.	119.0	.29708	578.2	7.29	.101	33.80	1.887	.00427	.8871	3.582	3.918	.99950
73.	60.0	.29708	579.1	6.47	.051	17.01	1.884	.00427	.8837	2.785	3.087	1.00000
74.	236.0	.55865	581.3	9.55	.200	125.55	1.866	.00227	.8684	6.378	6.809	.99794
75.	177.1	.56108	581.4	8.99	.150	94.64	1.866	.00226	.8664	5.625	6.034	.99983
76.	119.2	.56179	580.7	8.27	.101	63.82	1.869	.00226	.8694	4.725	5.104	.99911
77.	59.8	.56091	580.2	7.29	.051	31.97	1.870	.00226	.8702	3.630	3.968	1.00000
78.	58.7	.56214	562.7	7.36	.050	32.21	1.928	.00226	.9299	3.676	4.015	.99832
79.	116.8	.55853	560.5	8.33	.101	63.89	1.936	.00227	.9356	4.763	5.143	1.00022
80.	174.4	.57286	561.1	9.14	.151	97.74	1.934	.00222	.9346	5.769	6.181	.99915
81.	232.5	.56698	560.9	9.73	.201	128.97	1.934	.00224	.9348	6.563	7.000	.99938
82.	57.6	.59661	541.1	7.49	.051	34.58	2.005	.00213	1.0054	3.794	4.139	1.00000
83.	114.6	.59209	542.1	8.46	.100	68.14	2.001	.00214	1.0012	4.888	5.273	1.00009
84.	171.0	.58710	541.6	9.21	.150	100.91	2.003	.00216	1.0023	5.829	6.244	1.00117
85.	227.8	.58093	544.3	9.77	.200	132.50	1.993	.00219	.9951	6.598	7.035	.99827
89.	57.1	.03683	540.7	4.46	.050	2.11	1.910	.03447	.9100	1.386	1.620	1.00000
90.	114.7	.03691	538.5	4.90	.101	4.28	1.918	.03440	.9156	1.705	1.957	1.00210
91.	170.8	.03682	539.6	5.18	.150	6.34	1.914	.03448	.9118	1.919	2.182	1.00198
92.	228.0	.03664	540.5	5.39	.201	8.41	1.911	.03465	.9103	2.089	2.361	1.00032
93.	283.5	.03643	540.7	5.55	.250	10.39	1.910	.03485	.9101	2.225	2.503	1.00009
94.	339.0	.03615	540.7	5.68	.300	12.33	1.910	.03512	.9101	2.338	2.622	1.00010
95.	393.9	.03573	541.4	5.78	.350	14.15	1.908	.03554	.9089	2.425	2.712	.99874
96.	401.0	.03562	560.5	5.74	.350	13.98	1.842	.03564	.8481	2.407	2.692	.99433
97.	344.2	.03619	560.1	5.63	.299	12.20	1.844	.03509	.8506	2.317	2.599	.99320
98.	287.5	.03659	559.8	5.51	.249	10.31	1.845	.03470	.8474	2.215	2.492	.99747
99.	232.1	.03702	559.2	5.36	.201	8.43	1.847	.03430	.8520	2.090	2.361	.99483
100.	59.5	.03672	580.2	4.36	.050	2.08	1.780	.03458	.7799	1.351	1.581	1.00000
101.	118.4	.03694	580.1	4.79	.100	4.17	1.780	.03437	.7783	1.660	1.909	1.00202
102.	177.8	.03703	578.5	5.09	.151	6.29	1.785	.03428	.7858	1.894	2.155	.99943
103.	236.5	.03706	577.3	5.31	.202	8.39	1.789	.03426	.7875	2.069	2.340	1.00155
104.	294.4	.03682	583.5	5.44	.250	10.29	1.770	.03449	.7737	2.191	2.467	.99615
105.	349.9	.03731	582.6	5.62	.298	12.41	1.773	.03402	.7749	2.336	2.619	.99769
106.	403.5	.03705	580.8	5.73	.346	14.25	1.778	.03427	.7828	2.430	2.717	.99553
107.	173.6	.03903	558.8	5.20	.150	6.65	1.848	.03253	.8452	1.955	2.219	1.00301
108.	117.2	.03927	557.0	4.92	.101	4.53	1.854	.03233	.8517	1.736	1.989	1.00257
109.	59.2	.03926	561.6	4.47	.051	2.27	1.839	.03234	.8373	1.409	1.644	1.00179

Table II.4 Sensitivities for Y-wire probe computed based on $E = f(U, \rho, T_o)$

obs	vel	den	To	Mach	S(U)A	S(U)B	S(U)C	S(Rho)A	S(Rho)B	S(Rho)C	S(To)A	S(To)B	S(To)C
6.	401.0	.06836	560.4	.350	.114	.139	.117	.243	.229	.225	-.935	-.555	-.707
7.	345.0	.06908	560.9	.300	.158	.151	.160	.249	.234	.228	-.959	-.528	-.663
8.	288.1	.06983	560.0	.250	.152	.146	.614	.280	.234	.216	-.956	-.521	-.659
9.	232.8	.07183	558.1	.202	.169	.160	.272	.215	.213	.280	-.898	-.492	0.000
10.	173.2	.07152	560.2	.150	.177	.173	.000	.212	.213	.222	-.884	-.471	-.594
11.	116.4	.07165	558.9	.101	.178	.172	.178	.205	.204	.209	-.809	-.425	-.544
12.	58.7	.07166	558.6	.051	.000	.000	.000	.189	.193	.192	-.885	-.484	-.602
13.	58.1	.07437	538.4	.052	.000	.000	.000	.187	.192	.191	-.885	-.484	-.602
14.	113.7	.07443	538.4	.100	.183	.174	.180	.200	.202	.207	-.809	-.425	-.544
16.	170.4	.07431	539.7	.150	.176	.168	.173	.212	.212	.219	-.884	-.471	-.594
17.	228.2	.07432	540.2	.201	.177	.166	.173	.216	.549	.226	-.898	-.492	0.000
18.	284.0	.07381	540.4	.251	.168	.157	.164	.220	.221	.230	-.956	-.521	-.659
19.	339.4	.07337	542.0	.300	.138	.143	.148	.229	.221	.229	-.959	-.528	-.663
20.	392.6	.07236	543.6	.348	.000	.000	.000	.313	.251	.216	-.935	-.555	-.707
30.	350.7	.06766	580.3	.300	.161	.147	.154	.374	.264	.227	-.959	-.528	-.663
31.	292.5	.06830	580.5	.249	.167	.157	.163	.228	.223	.232	-.956	-.521	-.659
33.	236.8	.06884	580.2	.201	.170	.162	.167	.216	.217	.227	-.898	-.492	0.000
34.	177.2	.06927	580.0	.150	.171	.165	.170	.213	.213	.222	-.884	-.471	-.594
35.	120.3	.06975	578.6	.102	.181	.174	.180	.207	.205	.210	-.809	-.425	-.544
37.	60.0	.06984	579.8	.051	.067	.084	.089	.185	.194	.194	-.885	-.484	-.602
38.	118.3	.14600	555.2	.103	0.000	0.000	0.000	.205	.204	.209	-2.989	-.830	-.648
39.	118.3	.14567	559.1	.102	0.000	0.000	0.000	.205	.204	.209	-2.989	-.830	-.648
40.	58.4	.14562	560.7	.050	.000	.000	.000	.189	.193	.192	-2.248	-.878	-1.085
41.	174.9	.14485	559.8	.151	.182	.169	.172	.212	.213	.222	-2.092	-.917	-1.110
42.	231.1	.14364	560.4	.200	.204	.169	.186	.215	.213	.280	-1.979	-.916	-1.225
43.	290.1	.14223	561.3	.251	.034	.150	.213	.280	.234	.216	-2.084	-.944	-1.338
44.	346.0	.14053	558.9	.301	.002	.128	.197	.249	.234	.228	0.000	0.000	0.000
45.	385.1	.13908	561.7	.335	.000	.000	.000	.243	.229	.225	0.000	0.000	0.000
46.	118.0	.14309	580.3	.100	.196	.187	.190	.207	.205	.210	-2.989	-.830	-.648
47.	60.3	.14332	579.5	.051	.000	.000	.000	.185	.194	.194	-2.248	-.878	-1.085
48.	176.9	.14240	579.8	.150	.200	.179	.184	.213	.213	.222	-2.092	-.917	-1.110
49.	236.2	.14127	580.2	.201	.212	.173	.191	.216	.217	.227	-1.979	-.916	-1.225
50.	294.1	.13991	579.7	.251	.000	.000	.000	.228	.223	.232	-2.084	-.944	-1.338
51.	114.3	.17928	540.5	.100	0.000	0.000	0.000	.200	.202	.207	0.000	0.000	0.000
52.	340.3	.17300	541.5	.301	0.000	0.000	0.000	.229	.221	.229	0.000	0.000	0.000
53.	340.6	.17287	543.1	.301	0.000	0.000	0.000	.229	.221	.229	0.000	0.000	0.000
54.	284.5	.17404	540.5	.251	.000	.000	.000	.220	.221	.230	-2.084	-.944	-1.338
55.	228.0	.17552	538.5	.201	.219	.172	.210	.216	.549	.226	-1.979	-.916	-1.225
56.	170.6	.17659	539.7	.150	.228	.192	.211	.212	.212	.219	-2.092	-.917	-1.110
57.	57.1	.17790	540.2	.050	.000	.000	.000	.187	.192	.191	-2.248	-.878	-1.085
58.	57.7	.30473	539.4	.051	.000	.000	.000	.187	.192	.191	-.842	-.361	-.493
59.	114.3	.30379	539.8	.101	.231	.192	.214	.200	.202	.207	-.751	-.338	-.436
60.	171.3	.30146	540.0	.151	.235	.188	.233	.212	.212	.219	-.832	-.334	-.450
61.	227.6	.29895	539.7	.201	.195	.190	.222	.216	.549	.226	-.813	-.333	-.481
62.	284.3	.29490	542.9	.250	.188	.191	.220	.220	.221	.230	-.833	-.317	-.471
65.	232.3	.29457	562.0	.201	.206	.196	.226	.215	.213	.280	-.813	-.333	-.481
66.	173.4	.29631	560.7	.150	.221	.186	.227	.212	.213	.222	-.832	-.334	-.450
67.	115.6	.29740	558.7	.100	.227	.192	.214	.205	.204	.209	-.751	-.338	-.436
68.	58.8	.29774	558.2	.051	.000	.000	.000	.189	.193	.192	-.842	-.361	-.493
69.	235.5	.29452	580.9	.200	.193	.191	.218	.216	.217	.227	-.813	-.333	-.481
70.	294.2	.29166	582.5	.250	.000	.000	.000	.228	.223	.232	-.833	-.317	-.471
71.	177.5	.29619	578.2	.151	.225	.187	.225	.213	.213	.222	-.832	-.334	-.450
72.	119.0	.29708	578.2	.101	.233	.195	.219	.207	.205	.210	-.751	-.338	-.436
73.	60.0	.29708	579.1	.051	.000	.000	.000	.185	.194	.194	-.842	-.361	-.493
74.	236.0	.55865	581.3	.200	.000	.000	.000	.216	.217	.227	-1.059	11.318	-.547
75.	177.1	.56108	581.4	.150	.211	.214	.228	.213	.213	.222	-.996	-.402	-.523
76.	119.2	.56179	580.7	.101	.239	.215	.246	.207	.205	.210	-.955	-.401	-.571
77.	59.8	.56091	580.2	.051	.000	.000	.000	.185	.194	.194	-1.013	-.456	-.545
78.	58.7	.56214	562.7	.050	.000	.000	.000	.189	.193	.192	-1.013	-.456	-.545
79.	116.8	.55853	560.5	.101	.247	.223	.254	.205	.204	.209	-.955	-.401	-.571
80.	174.4	.57286	561.1	.151	.220	.195	.237	.212	.213	.222	-.996	-.402	-.523
81.	232.5	.56698	560.9	.201	.000	.000	.000	.215	.213	.280	-1.059	11.318	-.547
82.	57.6	.59661	541.1	.051	.000	.000	.000	.187	.192	.191	-1.013	-.456	-.545
83.	114.6	.59209	542.1	.100	.241	.211	.245	.200	.202	.207	-.955	-.401	-.571
84.	171.0	.58710	541.6	.150	.216	-.477	.221	.212	.212	.219	-.996	-.402	-.523
85.	227.8	.58093	544.3	.200	.000	.000	.000	.216	.549	.226	-1.059	.000	-.547
89.	57.1	.03683	540.7	.050	.000	.000	.000	.187	.192	.191	-1.038	-.551	-.637
90.	114.7	.03691	538.5	.101	.176	.157	.168	.200	.202	.207	-1.049	-.540	-.637
91.	170.8	.03682	539.6	.150	.164	.151	.160	.212	.212	.219	-.965	-.479	-.557
92.	228.0	.03664	540.5	.201	.162	.149	.157	.216	.549	.226	-.902	-.303	-.431
93.	283.5	.03643	540.7	.250	.165	.146	.156	.220	.221	.230	-.919	-.302	-.438
94.	339.0	.03615	540.7	.300	.156	.135	.148	.229	.221	.229	-.834	-.228	-.370
95.	393.9	.03573	541.4	.350	.000	.000	.000	.313	.251	.216	-.803	-.200	-.352
96.	401.0	.03562	560.5	.350	.000	.000	.000	.243	.229	.225	-.803	-.200	-.352
97.	344.2	.03619	560.1	.299	.151	.130	.140	.249	.234	.228	-.834	-.228	-.370
98.	287.5	.03659	559.8	.249	.143	.135	.142	.280	.234	.216	-.919	-.302	-.438
99.	232.1	.03702	559.2	.201	.144	.127	.138	.215	.213	.280	-.902	-.303	-.431
100.	59.5	.03672	580.2	.050	.000	.000	.000	.185	.194	.194	-1.038	-.551	-.637
101.	118.4	.03694	580.1	.100	.182	.163	.174	.207	.205	.210	-1.049	-.540	-.637
102.	177.8	.03703	578.5	.151	.183	.163	.174	.213	.213	.222	-.965	-.479	-.557
103.	236.5	.03706	577.3	.202	.148	.146	.153	.216	.217	.227	-.902	-.303	-.431
104.	294.4	.03682	583.5	.250	.159	.157	.160	.228	.223	.232	-.919	-.302	-.438
105.	349.9	.03731	582.6	.298	.204	.172	.181	.374	.264	.227	-.834	-.228	-.370
106.	403.5	.03705	580.8	.346	.000	.000	.000	.000	.889	.000	-.803	-.200	-.352
107.	173.6	.03903	558.8	.150	.156	.138	.148	.212	.213	.222	-.965	-.479	-.557
108.	117.2	.03927	557.0	.101	.179	.161	.171	.205	.204	.209	-1.049	-.540	-.637
109.	59.2	.03926	561.6	.051	.000	.000	.000	.189	.193	.192	-1.038	-.551	-.637

Table II.5 Sensitivities for parallel wire probe computed based on $E = f(U,\rho,T_o)$

obs	vel	den	To	Mach	S(U)A	S(U)B	S(U)C	S(Rho)A	S(Rho)B	S(Rho)C	S(To)A	S(To)B	S(To)C
6.	401.0	.06836	560.4	.350	.110	.126	.202	.209	.235	.215	-.748	-.609	-1.119
7.	345.0	.06908	560.9	.300	.147	.151	.173	.213	.238	.220	-.662	-.796	-1.190
8.	288.1	.06983	560.0	.250	.142	.148	.155	.211	.226	.204	-.651	-.782	-1.172
9.	232.8	.07183	558.1	.202	.157	.158	.158	.213	.214	.210	-.610	-.743	-1.141
10.	173.2	.07152	560.2	.150	.166	.161	.160	.206	.206	.206	1.964	-.561	-1.051
11.	116.4	.07165	558.9	.101	.165	.162	.161	.198	.194	.193	-.539	-.665	-1.030
12.	58.7	.07166	558.6	.051	.000	.000	.000	.187	.175	.174	-1.096	-.843	-1.133
13.	58.1	.07437	538.4	.052	.000	.000	.000	.185	.177	.173	-1.096	-.843	-1.133
14.	113.7	.07443	538.4	.100	.120	.151	.160	.195	.195	.191	-.539	-.665	-1.030
16.	170.4	.07431	539.7	.150	.168	.162	.162	.214	.208	.204	0.000	-.561	-1.051
17.	228.2	.07432	540.2	.201	.243	.186	.175	.213	.215	.208	-.610	-.743	-1.141
18.	284.0	.07381	540.4	.251	.151	.153	.156	.211	.222	.212	-.651	-.782	-1.172
19.	339.4	.07337	542.0	.300	.138	.122	.151	.198	.224	.213	-.662	-.796	-1.190
20.	392.6	.07236	543.6	.348	.000	.000	.000	.223	.243	.212	-.748	-.609	-1.119
30.	350.7	.06766	580.3	.300	.140	.144	.155	.232	.260	.211	-.662	-.796	-1.190
31.	292.5	.06830	580.5	.249	.150	.152	.159	.214	.223	.219	-.651	-.782	-1.172
33.	236.8	.06884	580.2	.201	.156	.156	.161	.212	.213	.210	-.610	-.743	-1.141
34.	177.2	.06927	580.0	.150	.159	.157	.154	.205	.208	.207	1.964	-.561	-1.051
35.	120.3	.06975	578.6	.102	.200	.174	.167	.198	.198	.197	-.539	-.665	-1.030
36.	59.2	.06978	580.0	.050	.000	.000	.000	.193	.178	.178	-1.096	-.843	-1.133
37.	60.0	.06984	579.8	.051	.000	.000	.000	.193	.178	.178	-1.096	-.843	-1.133
38.	118.3	.14600	555.2	.103	0.000	0.000	0.000	.198	.194	.193	-2.467	-.774	-1.186
39.	118.3	.14567	559.1	.102	0.000	0.000	0.000	.198	.194	.193	-2.467	-.774	-1.186
40.	58.4	.14562	560.7	.050	.000	.000	.000	.187	.175	.174	-1.072	-.984	-1.346
41.	174.9	.14485	559.8	.151	.161	.163	.164	.206	.206	.206	-1.084	-1.054	-1.486
42.	231.1	.14364	560.4	.200	.158	.186	.195	.213	.214	.210	-1.076	-1.198	-1.560
43.	290.1	.14223	561.3	.251	.147	.204	.226	.211	.226	.204	-1.103	-1.233	-1.641
44.	346.0	.14053	558.9	.301	.144	.194	.182	.213	.238	.220	0.000	0.000	0.000
45.	385.1	.13908	561.7	.335	.000	.000	.000	.209	.235	.215	0.000	0.000	0.000
46.	118.0	.14309	580.3	.100	.181	.177	.180	.198	.198	.197	-2.467	-.774	-1.186
47.	60.3	.14332	579.5	.051	.000	.000	.000	.193	.178	.178	-1.072	-.984	-1.346
48.	176.9	.14240	579.8	.150	.177	.178	.192	.205	.208	.207	-1.084	-1.054	-1.486
49.	236.2	.14127	580.2	.201	.172	.192	.205	.212	.213	.210	-1.076	-1.198	-1.560
50.	294.1	.13991	579.7	.251	.000	.000	.000	.214	.223	.219	-1.103	-1.233	-1.641
51.	114.3	.17928	540.5	.100	0.000	0.000	0.000	.195	.195	.191	0.000	0.000	0.000
52.	340.3	.17300	541.5	.301	0.000	0.000	0.000	.198	.224	.213	0.000	0.000	0.000
53.	340.6	.17287	543.1	.301	.000	.000	.000	.198	.224	.213	0.000	0.000	0.000
54.	284.5	.17404	540.5	.251	.000	.000	.000	.211	.222	.212	-1.103	-1.233	-1.641
55.	228.0	.17552	538.5	.201	.164	.204	.213	.213	.215	.208	-1.076	-1.198	-1.560
56.	170.6	.17659	539.7	.150	.185	.211	.215	.214	.208	.204	-1.084	-1.054	-1.486
57.	57.1	.17790	540.2	.050	.000	.000	.000	.185	.177	.173	-1.072	-.984	-1.346
58.	57.7	.30473	539.4	.051	.000	.000	.000	.185	.177	.173	-.443	-.814	-.839
59.	114.3	.30379	539.8	.101	.185	.207	.215	.195	.195	.191	-.366	-.810	-.834
60.	171.3	.30146	540.0	.151	.183	.221	.224	.214	.208	.204	-.417	-.786	-.883
61.	227.6	.29895	539.7	.201	.182	.191	.185	.213	.215	.208	-.380	-.771	-.953
62.	284.3	.29490	542.9	.250	.191	.161	.166	.211	.222	.212	-.423	-.625	-.790
65.	232.3	.29457	562.0	.201	.187	.219	.203	.213	.214	.210	-.380	-.771	-.953
66.	173.4	.29631	560.7	.150	.176	.217	.207	.206	.206	.206	-.417	-.786	-.883
67.	115.6	.29740	558.7	.100	.184	.207	.209	.198	.194	.193	-.366	-.810	-.834
68.	58.8	.29774	558.2	.051	.000	.000	.000	.187	.175	.174	-.443	-.814	-.839
69.	235.5	.29452	580.9	.200	.180	.207	.195	.212	.213	.210	-.380	-.771	-.953
70.	294.2	.29166	582.5	.250	.000	.000	.000	.214	.223	.219	-.423	-.625	-.790
71.	177.5	.29619	578.2	.151	.181	.220	.206	.205	.208	.207	-.417	-.786	-.883
72.	119.0	.29708	578.2	.101	.188	.213	.215	.198	.198	.197	-.366	-.810	-.834
73.	60.0	.29708	579.1	.051	.000	.000	.000	.193	.178	.178	-.443	-.814	-.839
74.	236.0	.55865	581.3	.200	.000	.000	.000	.212	.213	.210	-.607	-.573	-.915
75.	177.1	.56108	581.4	.150	.219	.215	.208	.205	.208	.207	-.594	-.532	-.894
76.	119.2	.56179	580.7	.101	.206	.234	.231	.198	.198	.197	-.553	-.520	-.927
77.	59.8	.56091	580.2	.051	.000	.000	.000	.193	.178	.178	-.561	-.559	-.952
78.	58.7	.56214	562.7	.050	.000	.000	.000	.187	.175	.174	-.561	-.559	-.952
79.	116.8	.55853	560.5	.101	.214	.242	.238	.198	.194	.193	-.553	-.520	-.927
80.	174.4	.57286	561.1	.151	.229	.225	.218	.206	.206	.206	-.594	-.532	-.894
81.	232.5	.56698	560.9	.201	.000	.000	.000	.213	.214	.210	-.607	-.573	-.915
82.	57.6	.59661	541.1	.051	.000	.000	.000	.185	.177	.173	-.561	-.559	-.952
83.	114.6	.59209	542.1	.100	.210	.232	.228	.195	.195	.191	-.553	-.520	-.927
84.	171.0	.58710	541.6	.150	.221	.215	.199	.214	.208	.204	-.594	-.532	-.894
85.	227.8	.58093	544.3	.200	.000	.000	.000	.213	.215	.208	-.607	-.573	-.915
89.	57.1	.03683	540.7	.050	.000	.000	.000	.185	.177	.173	-.592	-.783	-1.005
90.	114.7	.03691	538.5	.101	.152	.154	.153	.195	.195	.191	-.608	-.778	-1.019
91.	170.8	.03682	539.6	.150	.145	.147	.145	.214	.208	.204	-.507	-.651	-.901
92.	228.0	.03664	540.5	.201	.143	.145	.141	.213	.215	.208	-.379	-.426	-.788
93.	283.5	.03643	540.7	.250	.142	.147	.146	.211	.222	.212	-.416	-.519	-.899
94.	339.0	.03615	540.7	.300	.133	.142	.145	.198	.224	.213	-.343	-.427	-.817
95.	393.9	.03573	541.4	.350	.000	.000	.000	.223	.243	.212	-.319	-.396	-.781
96.	401.0	.03562	560.5	.350	.000	.000	.000	.209	.235	.215	-.319	-.396	-.781
97.	344.2	.03619	560.1	.299	.128	.131	.127	.213	.238	.220	-.343	-.427	-.817
98.	287.5	.03659	559.8	.249	.130	.130	.127	.211	.226	.204	-.416	-.519	-.899
99.	232.1	.03702	559.2	.201	.124	.118	.128	.213	.214	.210	-.379	-.426	-.788
100.	59.5	.03672	580.2	.050	.000	.000	.000	.193	.178	.178	-.592	-.783	-1.005
101.	118.4	.03694	580.1	.100	.158	.162	.161	.198	.198	.197	-.608	-.778	-1.019
102.	177.8	.03703	578.5	.151	.161	.169	.171	.205	.208	.207	-.507	-.651	-.901
103.	236.5	.03706	577.3	.202	.136	.134	.123	.212	.213	.210	-.379	-.426	-.788
104.	294.4	.03682	583.5	.250	.143	.142	.127	.214	.223	.219	-.416	-.519	-.899
105.	349.9	.03731	582.6	.298	.169	.186	.192	.232	.260	.211	-.343	-.427	-.817
106.	403.5	.03705	580.8	.346	.000	.000	.000	.909	.000	.000	-.319	-.396	-.781
107.	173.6	.03903	558.8	.150	.133	.129	.135	.206	.206	.206	-.507	-.651	-.901
108.	117.2	.03927	557.0	.101	.155	.157	.156	.198	.194	.193	-.608	-.778	-1.019
109.	59.2	.03926	561.6	.051	.000	.000	.000	.187	.175	.174	-.592	-.783	-1.005

Table II.6 Sensitivities for single wire probe computed based on $E = f(U, \rho, T_o)$

obs	vel	den	To	Mach	S(U)A	S(Rho)A	S(To)A
30	350.7	0.06766	580.3	0.3	0.14	0.24	-2.125
31	292.5	0.0683	580.5	0.249	0.149	0.218	-1.786
33	236.8	0.06884	580.2	0.201	0.154	0.214	-1.39
34	177.2	0.06927	580	0.15	0.157	0.207	-0.848
35	120.3	0.06975	578.6	0.102	0.165	0.199	-0.123
36	59.2	0.06978	580	0.05	0	0.188	-2.411
37	60	0.06984	579.8	0.051	0.066	0.188	-2.411
38	118.3	0.146	555.2	0.103	0	0.198	-0.478
39	118.3	0.14567	559.1	0.102	0	0.198	-0.478
40	58.4	0.14562	560.7	0.05	0	0.187	-0.878
41	174.9	0.14485	559.8	0.151	0.161	0.209	-0.914
42	231.1	0.14364	560.4	0.2	0.162	0.216	-0.919
43	290.1	0.14223	561.3	0.251	0.162	0.219	-0.938
44	346	0.14053	558.9	0.301	0.14	0.224	-2.367
46	118	0.14309	580.3	0.1	0.178	0.199	-0.478
47	60.3	0.14332	579.5	0.051	0	0.188	-0.878
48	176.9	0.1424	579.8	0.15	0.17	0.207	-0.914
49	236.2	0.14127	580.2	0.201	0.165	0.214	-0.919
50	294.1	0.13991	579.7	0.251	0	0.218	-0.938
51	114.3	0.17928	540.5	0.1	0.002	0.197	-1.78
52	340.3	0.173	541.5	0.301	0.012	0.217	-1.906
53	340.6	0.17287	543.1	0.301	0.005	0.217	-0.296
54	284.5	0.17404	540.5	0.251	0	0.216	-0.938
55	228	0.17552	538.5	0.201	0.163	0.215	-0.919
56	170.6	0.17659	539.7	0.15	0.183	0.207	-0.914
57	57.1	0.1779	540.2	0.05	0	0.187	-0.878
58	57.7	0.30473	539.4	0.051	0	0.187	-0.335
59	114.3	0.30379	539.8	0.101	0.183	0.197	-0.309
60	171.3	0.30146	540	0.151	0.179	0.207	-0.299
61	227.6	0.29895	539.7	0.201	0.179	0.215	-0.297
62	284.3	0.2949	542.9	0.25	0.196	0.216	-0.251
65	232.3	0.29457	562	0.201	0.188	0.216	-0.297
66	173.4	0.29631	560.7	0.15	0.177	0.209	-0.299
67	115.6	0.2974	558.7	0.1	0.184	0.198	-0.309
68	58.8	0.29774	558.2	0.051	0	0.187	-0.335
69	235.5	0.29452	580.9	0.2	0.185	0.214	-0.297
70	294.2	0.29166	582.5	0.25	0	0.218	-0.251
71	177.5	0.29619	578.2	0.151	0.178	0.207	-0.299
72	119	0.29708	578.2	0.101	0.187	0.199	-0.309
73	60	0.29708	579.1	0.051	0	0.188	-0.335
74	236	0.55865	581.3	0.2	0	0.214	-0.376
75	177.1	0.56108	581.4	0.15	0.218	0.207	-0.35
76	119.2	0.56179	580.7	0.101	0.208	0.199	-0.343
77	59.8	0.56091	580.2	0.051	0	0.188	-0.403
78	58.7	0.56214	562.7	0.05	0	0.187	-0.403
79	116.8	0.55853	560.5	0.101	0.216	0.198	-0.343
80	174.4	0.57286	561.1	0.151	0.231	0.209	-0.35
81	232.5	0.56698	560.9	0.201	0	0.216	-0.376
82	57.6	0.59661	541.1	0.051	0	0.187	-0.403
83	114.6	0.59209	542.1	0.1	0.205	0.197	-0.343
84	171	0.5871	541.6	0.15	0.216	0.207	-0.35
85	227.8	0.58093	544.3	0.2	0	0.215	-0.376
89	57.1	0.03683	540.7	0.05	0	0.187	-0.495
90	114.7	0.03691	538.5	0.101	0.147	0.197	-0.485
91	170.8	0.03682	539.6	0.15	0.141	0.207	-0.417
92	228	0.03664	540.5	0.201	0.139	0.215	-0.226
93	283.5	0.03643	540.7	0.25	0.136	0.216	-0.254
94	339	0.03615	540.7	0.3	0.126	0.217	-0.171
95	393.9	0.03573	541.4	0.35	0	0.907	-0.156
96	401	0.03562	560.5	0.35	0	0.22	-0.156
97	344.2	0.03619	560.1	0.299	0.121	0.224	-0.171
98	287.5	0.03659	559.8	0.249	0.126	0.219	-0.254
99	232.1	0.03702	559.2	0.201	0.119	0.216	-0.226
100	59.5	0.03672	580.2	0.05	0	0.188	-0.495
101	118.4	0.03694	580.1	0.1	0.154	0.199	-0.485
102	177.8	0.03703	578.5	0.151	0.154	0.207	-0.417
103	236.5	0.03706	577.3	0.202	0.134	0.214	-0.226
104	294.4	0.03682	583.5	0.25	0.146	0.218	-0.254
105	349.9	0.03731	582.6	0.298	0.161	0.24	-0.171
106	403.5	0.03705	580.8	0.346	0	0.922	-0.156
107	173.6	0.03903	558.8	0.15	0.13	0.209	-0.417
108	117.2	0.03927	557	0.101	0.151	0.198	-0.485
109	59.2	0.03926	561.6	0.051	0	0.187	-0.495

Table II.7 Sensitivities for Y-wire probe computed based on $Nu_t = f(M, Kn, \tau)$

obs	vel	den	To	Mach	S(U)A	S(U)B	S(U)C	S(Rho)A	S(Rho)B	S(Rho)C	S(To)A	S(To)B	S(To)C
8.	288.1	.06983	560.0	.250	.049	.060	.462	.228	.205	.156	-1.398	-.886	-1.279
9.	232.8	.07183	558.1	.202	.171	.161	.380	.193	.183	.247	-1.417	-.929	0.000
10.	173.2	.07152	560.2	.150	.176	.172	.000	.190	.183	.183	-1.707	-1.226	-1.457
11.	116.4	.07165	558.9	.101	.177	.171	.176	.182	.173	.170	-1.392	-.867	-1.069
12.	58.7	.07166	558.6	.051	.002	.001	.001	.163	.162	.151	-1.362	-.820	-1.036
13.	58.1	.07437	538.4	.052	.001	.001	.001	.163	.164	.153	-1.173	-.738	-.912
14.	113.7	.07443	538.4	.100	.000	.000	.000	.180	.174	.171	-.948	-.510	-.677
17.	228.2	.07432	540.2	.201	.000	.000	.000	.195	.912	.189	-1.731	-1.309	0.000
18.	284.0	.07381	540.4	.251	.174	.161	.169	.177	.184	.180	-1.321	-.865	-1.036
19.	339.4	.07337	542.0	.300	.153	.152	.162	.187	.200	.180	-1.832	-1.282	-1.503
20.	392.6	.07236	543.6	.348	.029	.027	.043	.159	.220	.164	-4.924	-3.658	-4.294
30.	350.7	.06766	580.3	.300	.169	.153	.163	.096	.182	.105	-2.242	-1.460	-1.767
31.	292.5	.06830	580.5	.249	.170	.159	.166	.178	.182	.180	-1.650	-1.025	-1.252
33.	236.8	.06884	580.2	.201	.173	.164	.225	.197	.189	.191	-1.611	-1.022	0.000
34.	177.2	.06927	580.0	.150	.176	.168	.173	.193	.185	.186	-1.900	-1.309	-1.688
35.	120.3	.06975	578.6	.102	.561	.558	.560	.185	.176	.174	-1.740	-1.136	-1.352
36.	59.2	.06978	580.0	.050	.002	.001	.001	.166	.166	.157	-1.529	-.909	-1.141
40.	58.4	.14562	560.7	.050	.002	.001	.001	.163	.162	.151	-1.683	-.893	-1.154
41.	174.9	.14485	559.8	.151	.195	.174	.178	.190	.183	.183	-1.727	-1.059	-1.299
42.	231.1	.14364	560.4	.200	.210	.172	.191	.193	.183	.247	-1.689	-1.106	-1.506
43.	290.1	.14223	561.3	.251	.035	.150	.214	.228	.205	.156	-1.578	-1.135	-1.516
46.	118.0	.14309	580.3	.100	.195	.184	.187	.185	.176	.174	-2.347	-.978	-.905
47.	60.3	.14332	579.5	.051	.002	.001	.001	.166	.166	.157	-2.174	-.999	-1.264
48.	176.9	.14240	579.8	.150	.201	.179	.184	.193	.185	.186	-2.187	-1.173	-1.416
49.	236.2	.14127	580.2	.201	.214	.175	.194	.197	.189	.191	-2.139	-1.218	-1.616
50.	294.1	.13991	579.7	.251	.011	.008	.012	.178	.182	.180	-2.023	-1.173	-1.534
54.	284.5	.17404	540.5	.251	.009	.007	.010	.177	.184	.180	-1.587	-1.005	-1.287
55.	228.0	.17552	538.5	.201	.222	.173	.213	.195	.912	.189	-1.698	-1.041	-1.393
56.	170.6	.17659	539.7	.150	.222	.187	.207	.190	.186	.182	-1.750	-1.004	-1.204
57.	57.1	.17790	540.2	.050	.002	.001	.001	.163	.164	.153	-1.692	-.828	-1.041
58.	57.7	.30473	539.4	.051	.001	.001	.001	.163	.164	.153	-.722	-.319	-.433
59.	114.3	.30379	539.8	.101	.230	.189	.213	.180	.174	.171	-.753	-.405	-.515
60.	171.3	.30146	540.0	.151	.232	.187	.232	.190	.186	.182	-.848	-.402	-.528
61.	227.6	.29895	539.7	.201	.202	.192	.225	.195	.912	.189	-.815	-.402	-.552
62.	284.3	.29490	542.9	.250	.201	.195	.226	.177	.184	.180	-.820	-.380	-.530
65.	232.3	.29457	562.0	.201	.208	.196	.227	.193	.183	.247	-.955	-.460	-.630
66.	173.4	.29631	560.7	.150	.224	.186	.228	.190	.183	.183	-.978	-.455	-.595
67.	115.6	.29740	558.7	.100	.227	.189	.213	.182	.173	.170	-.874	-.457	-.585
68.	58.8	.29774	558.2	.051	.001	.001	.001	.163	.162	.151	-.840	-.370	-.500
69.	235.5	.29452	580.9	.200	.204	.195	.224	.197	.189	.191	-1.116	-.517	-.708
70.	294.2	.29166	582.5	.250	.007	.005	.007	.178	.182	.180	-1.009	-.395	-.571
71.	177.5	.29619	578.2	.151	.229	.187	.226	.193	.185	.186	-1.113	-.507	-.664
72.	119.0	.29708	578.2	.101	.229	.191	.215	.185	.176	.174	-1.019	-.511	-.655
73.	60.0	.29708	579.1	.051	.001	.001	.001	.166	.166	.157	-1.008	-.431	-.581
74.	236.0	.55865	581.3	.200	.007	.000	.005	.197	.189	.191	-1.271	.000	-.650
75.	177.1	.56108	581.4	.150	.211	.212	.225	.193	.185	.186	-1.313	-.590	-.736
76.	119.2	.56179	580.7	.101	.235	.213	.242	.185	.176	.174	-1.325	-.602	-.813
77.	59.8	.56091	580.2	.051	.002	.001	.001	.166	.166	.157	-1.246	-.550	-.675
78.	58.7	.56214	562.7	.050	.001	.001	.001	.163	.162	.151	-1.076	-.490	-.598
79.	116.8	.55853	560.5	.101	.239	.220	.249	.182	.173	.170	-1.154	-.543	-.729
80.	174.4	.57286	561.1	.151	.219	.191	.234	.190	.183	.183	-1.143	-.517	-.657
81.	232.5	.56698	560.9	.201	.006	.000	.005	.193	.183	.247	-1.092	.000	-.569
82.	57.6	.59661	541.1	.051	.001	.001	.001	.163	.164	.153	-.909	-.425	-.517
83.	114.6	.59209	542.1	.100	.235	.209	.239	.180	.174	.171	-1.007	-.483	-.653
84.	171.0	.58710	541.6	.150	.219	.000	.221	.190	.186	.182	-.984	-.180	-.576
85.	227.8	.58093	544.3	.200	.005	.000	.004	.195	.912	.189	-.947	.000	-.502
89.	57.1	.03683	540.7	.050	.009	.001	.001	.163	.164	.153	0.0000	-.731	-1.080
90.	114.7	.03691	538.5	.101	.173	.155	.165	.180	.174	.171	-1.653	-.719	-.936
91.	170.8	.03682	539.6	.150	.164	.153	.164	.190	.186	.182	.911	-.927	-1.601
92.	228.0	.03664	540.5	.201	.164	.150	.160	.195	.912	.189	-.434	-.350	-.842
93.	283.5	.03643	540.7	.250	.165	.146	.156	.177	.184	.180	-.804	-.326	-.450
94.	339.0	.03615	540.7	.300	.159	.134	.149	.187	.200	.180	-.711	-.012	-.297
95.	393.9	.03573	541.4	.350	.008	.006	.010	.159	.220	.164	-.642	-.029	-.219
96.	401.0	.03562	560.5	.350	.009	.006	.011	.238	.221	.220	-.775	-.073	-.282
97.	344.2	.03619	560.1	.299	.154	.130	.141	.194	.207	.179	-.841	-.050	-.353
98.	287.5	.03659	559.8	.249	.147	.136	.144	.228	.205	.156	-.934	-.374	-.515
99.	232.1	.03702	559.2	.201	.146	.129	.142	.193	.183	.247	-.533	-.397	-.933
100.	59.5	.03672	580.2	.050	.012	.001	.001	.166	.166	.157	0.000	-.908	-1.352
101.	118.4	.03694	580.1	.100	.177	.160	.169	.185	.176	.174	-2.190	-.892	-1.178
102.	177.8	.03703	578.5	.151	.168	.160	.171	.193	.185	.186	.913	-1.106	-1.906
103.	236.5	.03706	577.3	.202	.168	.153	.165	.197	.189	.191	-.692	-.471	-1.049
104.	294.4	.03682	583.5	.250	.184	.165	.173	.178	.182	.180	-1.174	-.461	-.634
105.	349.9	.03731	582.6	.298	.183	.164	.170	.096	.182	.105	-1.047	-.122	-.458
107.	173.6	.03903	558.8	.150	.156	.140	.152	.190	.183	.183	.917	-1.004	-1.733
108.	117.2	.03927	557.0	.101	.174	.158	.167	.182	.173	.170	-1.859	-.792	-1.030
109.	59.2	.03926	561.6	.051	.011	.001	.001	.163	.162	.151	0.000	-.820	-1.211

Table II.8 Sensitivities for parallel wire probe computed based on $Nu_t = f(M,Kn,\tau)$

obs	vel	den	To	Mach	S(U)A	S(U)B	S(U)C	S(Rho)A	S(Rho)B	S(Rho)C	S(To)A	S(To)B	S(To)C
6.	401.0	.06836	560.4	.350	.126	.145	.239	.240	.162	.191	-.888	-.759	-1.142
7.	345.0	.06908	560.9	.300	.150	.154	.177	.243	.163	.197	-.756	-.837	-1.254
8.	288.1	.06983	560.0	.250	.149	.157	.168	.242	.153	.183	-.755	-.873	-1.248
9.	232.8	.07183	558.1	.202	.158	.160	.160	.207	.208	.206	-.716	-.836	-1.247
10.	173.2	.07152	560.2	.150	.164	.159	.157	.200	.199	.201	-.627	-.844	-1.293
11.	116.4	.07165	558.9	.101	.164	.161	.161	.191	.184	.188	-.645	-.748	-1.128
12.	58.7	.07166	558.6	.051	.001	.001	.001	.181	.172	.168	-.625	-.766	-1.144
13.	58.1	.07437	538.4	.052	.001	.001	.001	.181	.175	.167	-.540	-.653	-.953
14.	113.7	.07443	538.4	.100	.000	.000	.000	.190	.189	.186	-.295	-.379	-.686
17.	228.2	.07432	540.2	.201	.000	.000	.000	.209	.209	.203	-1.098	-1.194	-1.551
18.	284.0	.07381	540.4	.251	.157	.160	.164	.211	.246	.201	-.689	-.786	-1.095
19.	339.4	.07337	542.0	.300	.147	.133	.167	.237	.166	.198	-.686	-.741	-1.101
20.	392.6	.07236	543.6	.348	.015	.010	.013	.237	.207	.116	-.767	-.622	-.838
30.	350.7	.06766	580.3	.300	.144	.148	.161	.246	.206	.069	-.835	-.958	-1.421
31.	292.5	.06830	580.5	.249	.153	.155	.162	.211	.256	.207	-.839	-.980	-1.422
33.	236.8	.06884	580.2	.201	.157	.158	.164	.205	.209	.206	-.794	-.936	-1.405
34.	177.2	.06927	580.0	.150	.160	.159	.157	.199	.202	.202	-.687	-.930	-1.449
35.	120.3	.06975	578.6	.102	.554	.553	.552	.191	.191	.190	-.915	-1.045	-1.466
36.	59.2	.06978	580.0	.050	.001	.001	.001	.181	.176	.171	-.698	-.857	-1.276
40.	58.4	.14562	560.7	.050	.001	.001	.001	.181	.172	.168	-1.121	-1.043	-1.413
41.	174.9	.14485	559.8	.151	.167	.170	.176	.200	.199	.201	-1.272	-1.194	-1.737
42.	231.1	.14364	560.4	.200	.162	.190	.202	.207	.208	.206	-1.308	-1.401	-1.888
43.	290.1	.14223	561.3	.251	.149	.206	.225	.242	.153	.183	-1.319	-1.418	-1.852
46.	118.0	.14309	580.3	.100	.179	.175	.179	.191	.191	.190	-.973	-.968	-1.504
47.	60.3	.14332	579.5	.051	.001	.002	.001	.181	.176	.171	-1.236	-1.156	-1.609
48.	176.9	.14240	579.8	.150	.178	.179	.192	.199	.202	.202	-1.389	-1.307	-1.933
49.	236.2	.14127	580.2	.201	.175	.195	.207	.205	.209	.206	-1.420	-1.533	-2.086
50.	294.1	.13991	579.7	.251	.012	.010	.013	.211	.256	.207	-1.351	-1.446	-1.933
54.	284.5	.17404	540.5	.251	.010	.009	.010	.211	.246	.201	-1.149	-1.229	-1.524
55.	228.0	.17552	538.5	.201	.167	.207	.218	.209	.209	.203	-1.208	-1.317	-1.691
56.	170.6	.17659	539.7	.150	.181	.209	.210	.203	.206	.188	-1.185	-1.124	-1.565
57.	57.1	.17790	540.2	.050	.001	.001	.001	.181	.175	.167	-1.026	-.963	-1.239
58.	57.7	.30473	539.4	.051	.000	.001	.001	.181	.175	.167	-.392	-.752	-.738
59.	114.3	.30379	539.8	.101	.183	.206	.213	.190	.189	.186	-.420	-.850	-.889
60.	171.3	.30146	540.0	.151	.182	.221	.223	.203	.206	.188	-.484	-.876	-.965
61.	227.6	.29895	539.7	.201	.185	.195	.191	.209	.209	.203	-.442	-.805	-.933
62.	284.3	.29490	542.9	.250	.197	.171	.180	.211	.246	.201	-.489	-.622	-.770
65.	232.3	.29457	562.0	.201	.189	.221	.206	.207	.208	.206	-.506	-.958	-1.105
66.	173.4	.29631	560.7	.150	.177	.220	.211	.200	.199	.201	-.542	-1.007	-1.083
67.	115.6	.29740	558.7	.100	.181	.208	.209	.191	.184	.188	-.476	-.997	-1.020
68.	58.8	.29774	558.2	.051	.000	.001	.001	.181	.172	.168	-.450	-.889	-.868
69.	235.5	.29452	580.9	.200	.184	.216	.208	.205	.209	.206	-.566	-1.075	-1.268
70.	294.2	.29166	582.5	.250	.007	.008	.009	.211	.256	.207	-.518	-.760	-.960
71.	177.5	.29619	578.2	.151	.182	.223	.210	.199	.202	.202	-.600	-1.105	-1.236
72.	119.0	.29708	578.2	.101	.183	.209	.211	.191	.191	.190	-.533	-1.088	-1.155
73.	60.0	.29708	579.1	.051	.001	.002	.001	.181	.176	.171	-.519	-.994	-1.024
74.	236.0	.55865	581.3	.200	.006	.005	.006	.205	.209	.206	-.708	-.638	-1.100
75.	177.1	.56108	581.4	.150	.220	.215	.208	.199	.202	.202	-.813	-.750	-1.178
76.	119.2	.56179	580.7	.101	.205	.230	.228	.191	.191	.190	-.783	-.760	-1.241
77.	59.8	.56091	580.2	.051	.001	.001	.001	.181	.176	.171	-.666	-.664	-1.154
78.	58.7	.56214	562.7	.050	.001	.001	.001	.181	.172	.168	-.599	-.587	-.995
79.	116.8	.55853	560.5	.101	.211	.237	.231	.191	.184	.188	-.712	-.690	-1.080
80.	174.4	.57286	561.1	.151	.228	.224	.217	.200	.199	.201	-.741	-.681	-1.023
81.	232.5	.56698	560.9	.201	.005	.005	.006	.207	.208	.206	-.628	-.557	-.938
82.	57.6	.59661	541.1	.051	.000	.001	.001	.181	.175	.167	-.525	-.523	-.849
83.	114.6	.59209	542.1	.100	.208	.226	.223	.190	.189	.186	-.646	-.627	-.939
84.	171.0	.58710	541.6	.150	.222	.216	.201	.203	.206	.188	-.670	-.618	-.880
85.	227.8	.58093	544.3	.200	.005	.004	.005	.209	.209	.203	-.569	-.495	-.807
89.	57.1	.03683	540.7	.050	.001	.001	.001	.181	.175	.167	-.592	-.860	-1.091
90.	114.7	.03691	538.5	.101	.150	.152	.151	.190	.189	.186	-.643	-.853	-1.067
91.	170.8	.03682	539.6	.150	.147	.150	.149	.203	.206	.188	-.580	-.970	-1.031
92.	228.0	.03664	540.5	.201	.145	.147	.144	.209	.209	.203	-.397	-.457	-.771
93.	283.5	.03643	540.7	.250	.143	.148	.147	.211	.246	.201	-.447	-.546	-.837
94.	339.0	.03615	540.7	.300	.135	.145	.148	.237	.166	.198	-.378	-.581	-.828
95.	393.9	.03573	541.4	.350	.011	.012	.014	.237	.207	.116	-.303	-.746	-.824
96.	401.0	.03562	560.5	.350	.012	.013	.015	.240	.162	.191	-.358	-.841	-.984
97.	344.2	.03619	560.1	.299	.130	.135	.131	.243	.163	.197	-.429	-.651	-.937
98.	287.5	.03659	559.8	.249	.132	.132	.130	.242	.153	.183	-.500	-.611	-.946
99.	232.1	.03702	559.2	.201	.126	.120	.132	.207	.208	.206	-.444	-.511	-.876
100.	59.5	.03672	580.2	.050	.001	.002	.001	.181	.176	.171	-.745	-1.091	-1.476
101.	118.4	.03694	580.1	.100	.155	.159	.156	.191	.191	.190	-.805	-1.082	-1.442
102.	177.8	.03703	578.5	.151	.158	.165	.163	.199	.202	.202	-.726	-1.187	-1.369
103.	236.5	.03706	577.3	.202	.142	.142	.139	.205	.209	.206	-.518	-.603	-1.049
104.	294.4	.03682	583.5	.250	.151	.154	.149	.211	.256	.207	-.582	-.709	-1.171
105.	349.9	.03731	582.6	.298	.164	.178	.176	.246	.206	.069	-.527	-.779	-1.170
106.	403.5	.03705	580.8	.346	.013	.013	.017	.000	.000	.000	-.427	-.937	-1.153
107.	173.6	.03903	558.8	.150	.134	.132	.140	.200	.199	.201	-.642	-1.044	-1.179
108.	117.2	.03927	557.0	.101	.152	.153	.151	.191	.184	.188	-.711	-.910	-1.197
109.	59.2	.03926	561.6	.051	.001	.001	.001	.181	.172	.168	-.671	-.945	-1.283

Table II.9 Sensitivities for single wire probe computed based on $Nu_t = f(M, Kn, \tau)$

obs	vel	den	To	Mach	S(U)A	S(Rho)A	S(To)A
37	60	0.06984	579.8	0.051	0.066	0.188	-2.411
38	118.3	0.146	555.2	0.103	0.876	0.177	-0.96
39	118.3	0.14567	559.1	0.102	0.879	0.177	-0.968
40	58.4	0.14562	560.7	0.05	0	0.166	-0.906
41	174.9	0.14485	559.8	0.151	0.163	0.188	-1.038
42	231.1	0.14364	560.4	0.2	0.164	0.196	-1.065
43	290.1	0.14223	561.3	0.251	0.162	0.191	-1.058
44	346	0.14053	558.9	0.301	0.133	0.196	2.303
45	385.1	0.13908	561.7	0.335	0	0.192	0
46	118	0.14309	580.3	0.1	0.175	0.179	-0.673
47	60.3	0.14332	579.5	0.051	0	0.167	-0.98
48	176.9	0.1424	579.8	0.15	0.17	0.187	-1.12
49	236.2	0.14127	580.2	0.201	0.166	0.194	-1.142
50	294.1	0.13991	579.7	0.251	0.006	0.19	-1.055
51	114.3	0.17928	540.5	0.1	0.001	0.177	1.734
52	340.3	0.173	541.5	0.301	0.003	0.194	1.859
53	340.6	0.17287	543.1	0.301	0.004	0.194	0.399
54	284.5	0.17404	540.5	0.251	0.005	0.19	-0.905
55	228	0.17552	538.5	0.201	0.164	0.195	-0.986
56	170.6	0.17659	539.7	0.15	0.179	0.188	-0.973
57	57.1	0.1779	540.2	0.05	0	0.167	-0.832
58	57.7	0.30473	539.4	0.051	0	0.167	-0.289
59	114.3	0.30379	539.8	0.101	0.18	0.177	-0.355
60	171.3	0.30146	540	0.151	0.178	0.188	-0.356
61	227.6	0.29895	539.7	0.201	0.18	0.195	-0.35
62	284.3	0.2949	542.9	0.25	0.199	0.19	-0.306
65	232.3	0.29457	562	0.201	0.188	0.196	-0.404
66	173.4	0.29631	560.7	0.15	0.177	0.188	-0.403
67	115.6	0.2974	558.7	0.1	0.182	0.177	-0.404
68	58.8	0.29774	558.2	0.051	0	0.166	-0.338
69	235.5	0.29452	580.9	0.2	0.188	0.194	-0.453
70	294.2	0.29166	582.5	0.25	0.003	0.19	-0.302
71	177.5	0.29619	578.2	0.151	0.179	0.187	-0.449
72	119	0.29708	578.2	0.101	0.183	0.179	-0.455
73	60	0.29708	579.1	0.051	0	0.167	-0.391
74	236	0.55865	581.3	0.2	0.003	0.194	-0.431
75	177.1	0.56108	581.4	0.15	0.216	0.187	-0.513
76	119.2	0.56179	580.7	0.101	0.206	0.179	-0.513
77	59.8	0.56091	580.2	0.051	0	0.167	-0.467
78	58.7	0.56214	562.7	0.05	0	0.166	-0.416
79	116.8	0.55853	560.5	0.101	0.213	0.177	-0.462
80	174.4	0.57286	561.1	0.151	0.228	0.188	-0.463
81	232.5	0.56698	560.9	0.201	0.002	0.196	-0.376
82	57.6	0.59661	541.1	0.051	0	0.167	-0.36
83	114.6	0.59209	542.1	0.1	0.202	0.177	-0.41
84	171	0.5871	541.6	0.15	0.216	0.188	-0.409
85	227.8	0.58093	544.3	0.2	0.002	0.195	-0.332
89	57.1	0.03683	540.7	0.05	0	0.167	-0.56
90	114.7	0.03691	538.5	0.101	0.145	0.177	-0.581
91	170.8	0.03682	539.6	0.15	0.142	0.188	-0.679
92	228	0.03664	540.5	0.201	0.139	0.195	-0.258
93	283.5	0.03643	540.7	0.25	0.136	0.19	-0.27
94	339	0.03615	540.7	0.3	0.167	0.194	0
95	393.9	0.03573	541.4	0.35	0.004	.000	0.208
96	401	0.03562	560.5	0.35	0.004	0.192	0.177
97	344.2	0.03619	560.1	0.299	0.165	0.196	0
98	287.5	0.03659	559.8	0.249	0.126	0.191	-0.312
99	232.1	0.03702	559.2	0.201	0.12	0.196	-0.291
100	59.5	0.03672	580.2	0.05	0	0.167	-0.697
101	118.4	0.03694	580.1	0.1	0.151	0.179	-0.724
102	177.8	0.03703	578.5	0.151	0.152	0.187	-0.819
103	236.5	0.03706	577.3	0.202	0.138	0.194	-0.355
104	294.4	0.03682	583.5	0.25	0.152	0.19	-0.39
105	349.9	0.03731	582.6	0.298	0.203	.000	0
106	403.5	0.03705	580.8	0.346	0.004	.000	0.14
107	173.6	0.03903	558.8	0.15	0.13	0.188	-0.74
108	117.2	0.03927	557	0.101	0.148	0.177	-0.642
109	59.2	0.03926	561.6	0.051	0	0.166	-0.632

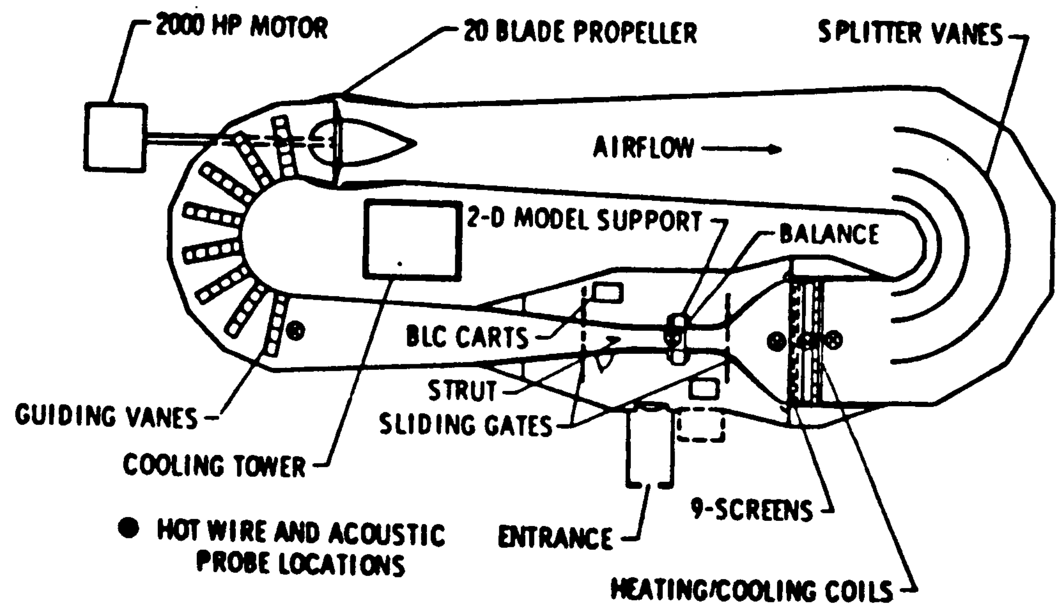

Figure 1. NASA Langley Low Turbulence Pressure Tunnel (LTPT)

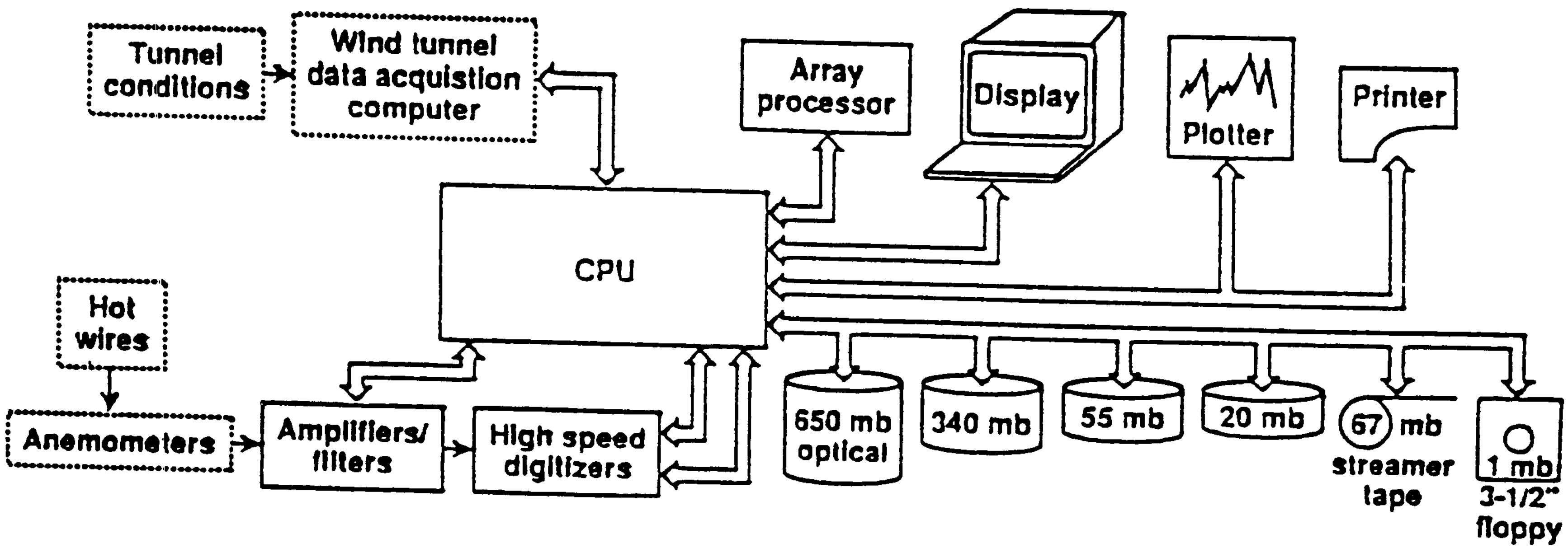

Figure 2. Data acquisition system block diagram

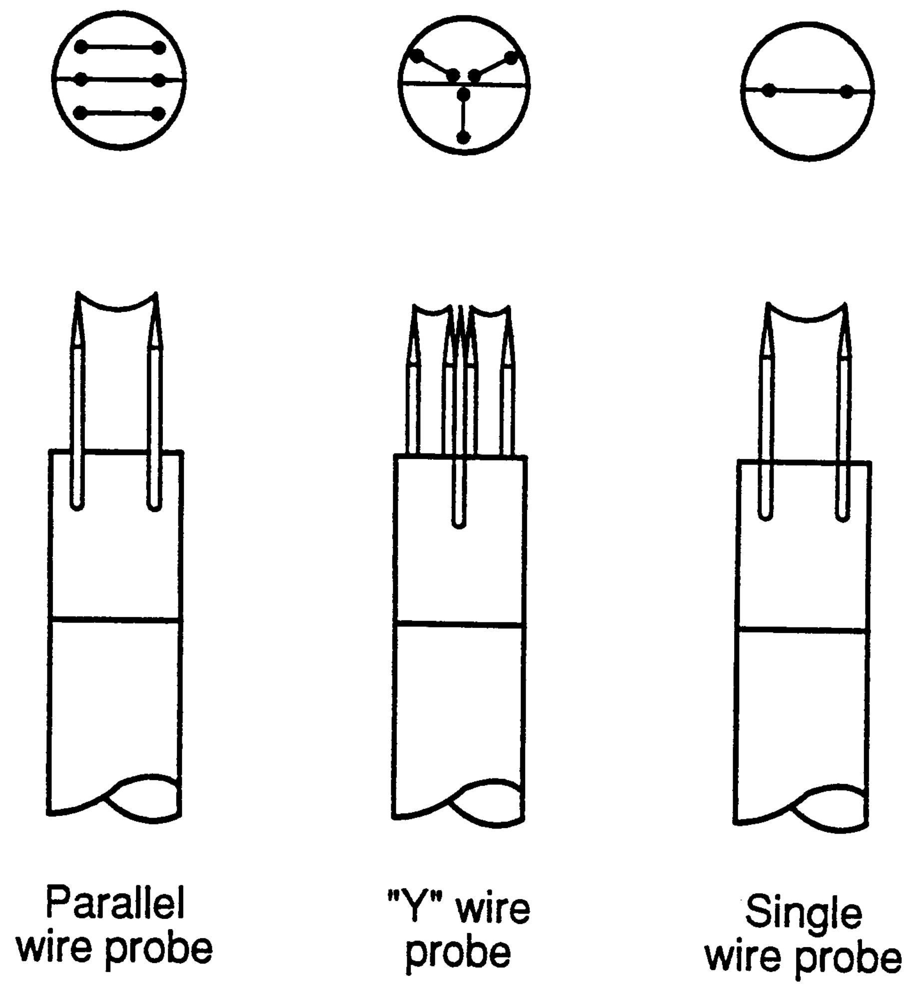

Figure 3. Geometry of probes

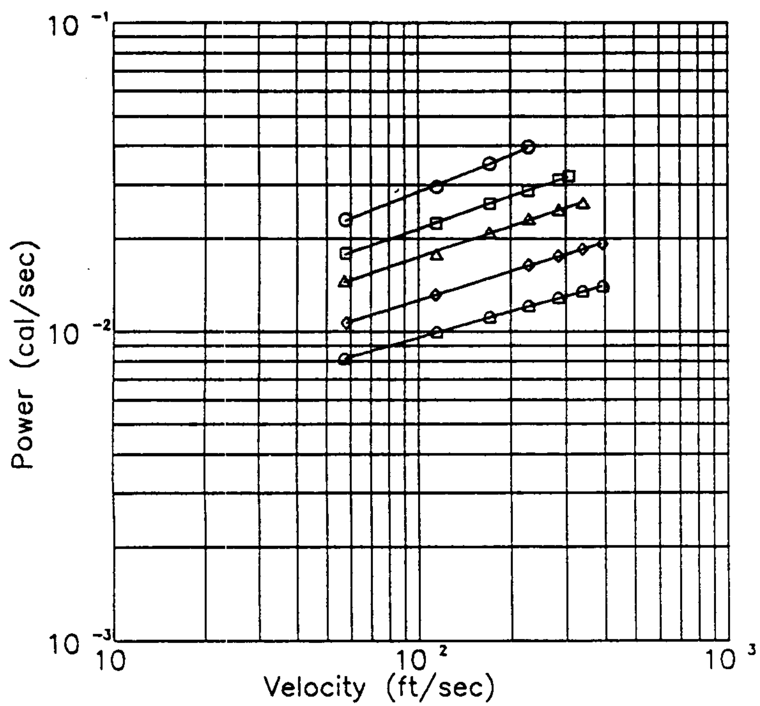

Figure 4.1 Velocity vs. Power
To = 80 F, Dw = 0.00015 inch, P—wire
(Data corrected due to Impedance)
Symbols: ○ 0.50 Atmosphere; ◇ 1.00 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

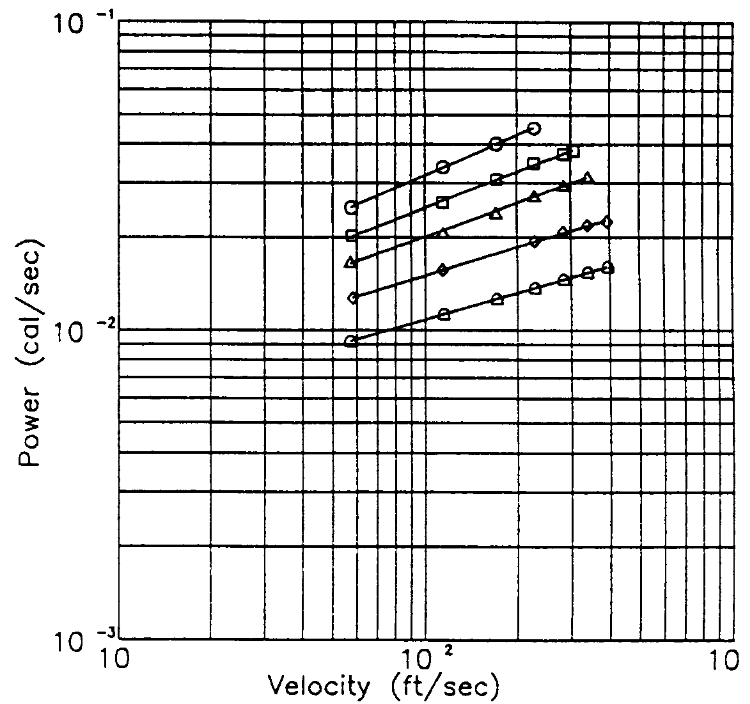

Figure 4.2 Velocity vs. Power
To = 80 F, Dw = 0.00032 inch, P—wire
(Data corrected due to Impedance)
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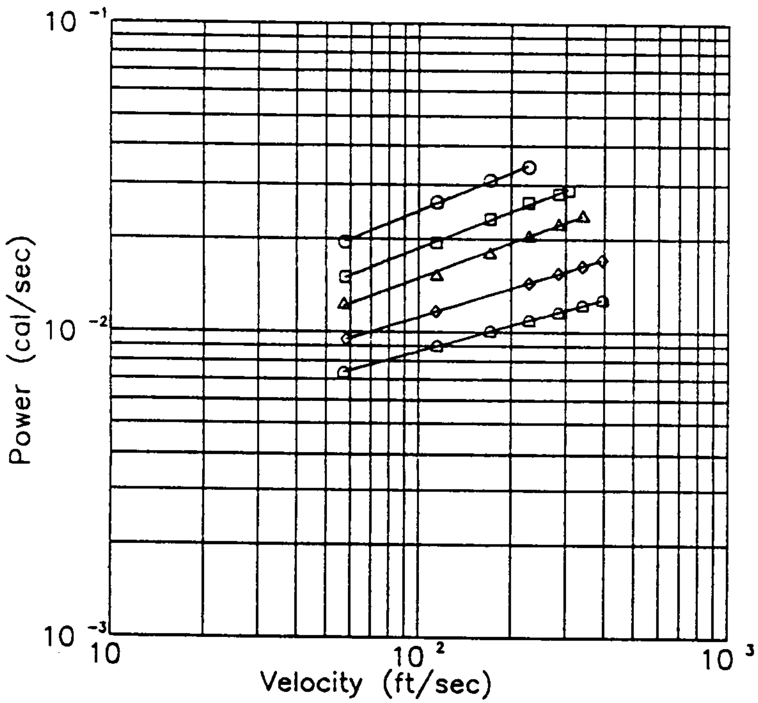

Figure 4.3 Velocity vs. Power
To = 80 F, Dw = 0.00050 inch, P–wire
(Data corrected due to impedance)
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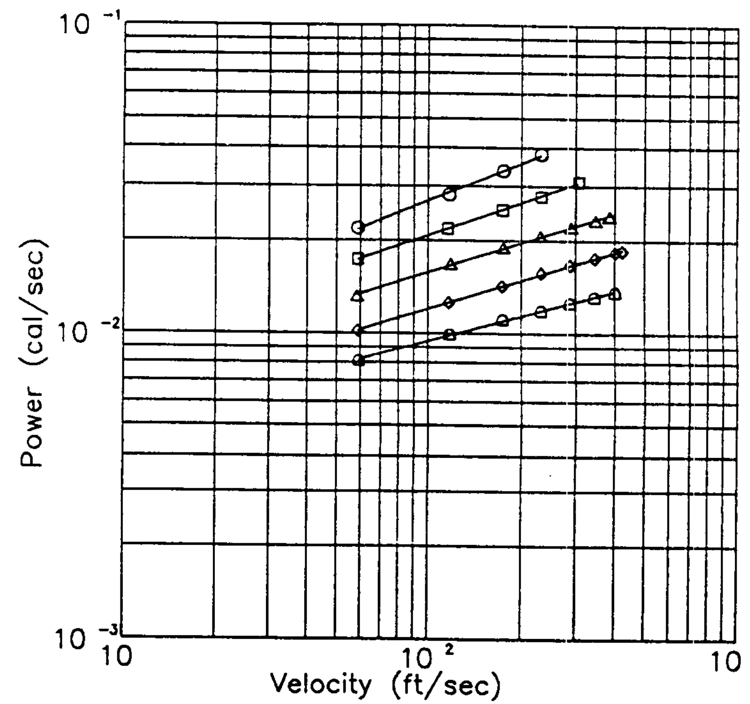

Figure 4.4 Velocity vs. Power
To = 100 F, Dw = 0.00015 inch, P–wire
(Data corrected due to impedance)
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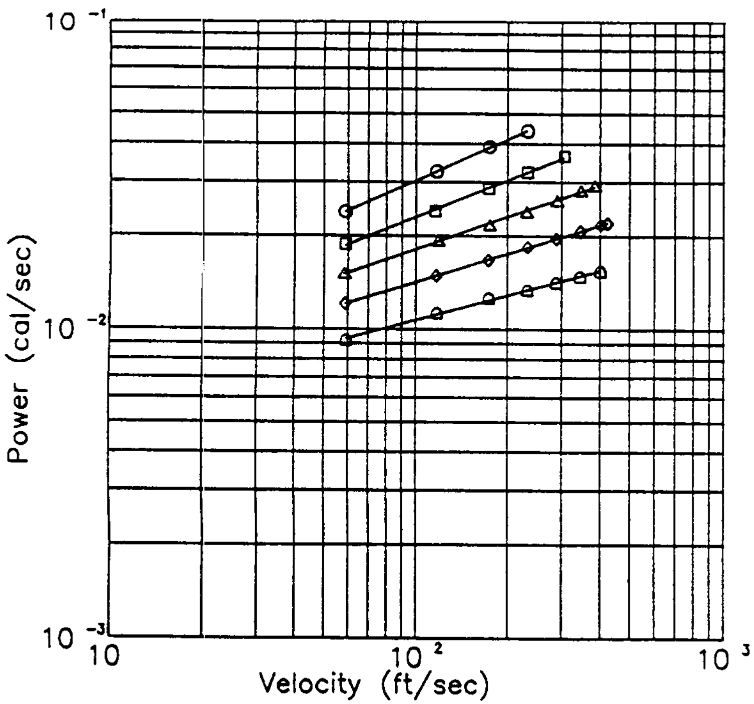

Figure 4.5 Velocity vs. Power
To = 100 F, Dw = 0.00032 inch, P-wire
(Data corrected due to Impedance)
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△ 2.00 Atmosphere; □ 4.00 Atmosphere;
○ 8.00 Atmosphere;

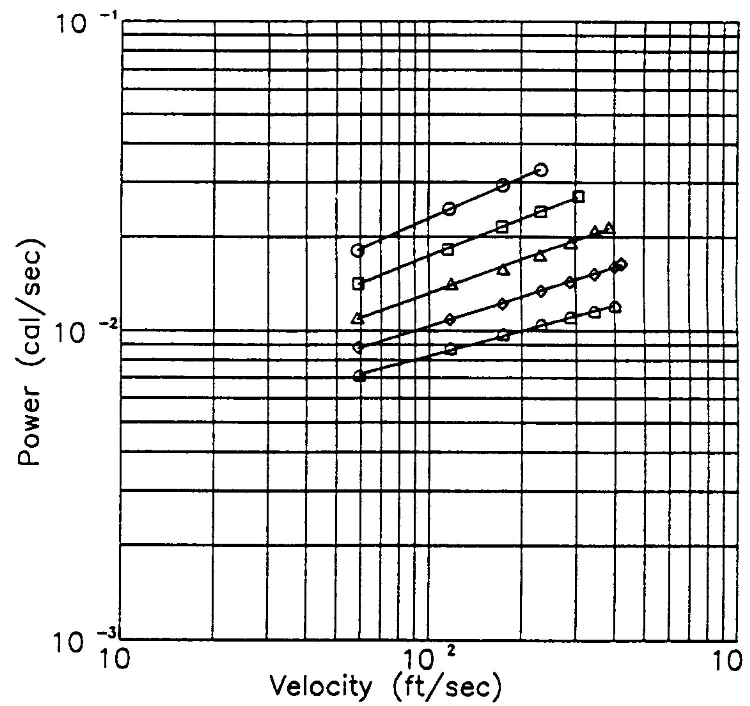

Figure 4.6 Velocity vs. Power
To = 100 F, Dw = 0.00050 inch, P-wire
(Data corrected due to Impedance)
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△ 2.00 Atmosphere; □ 4.00 Atmosphere;
○ 8.00 Atmosphere;

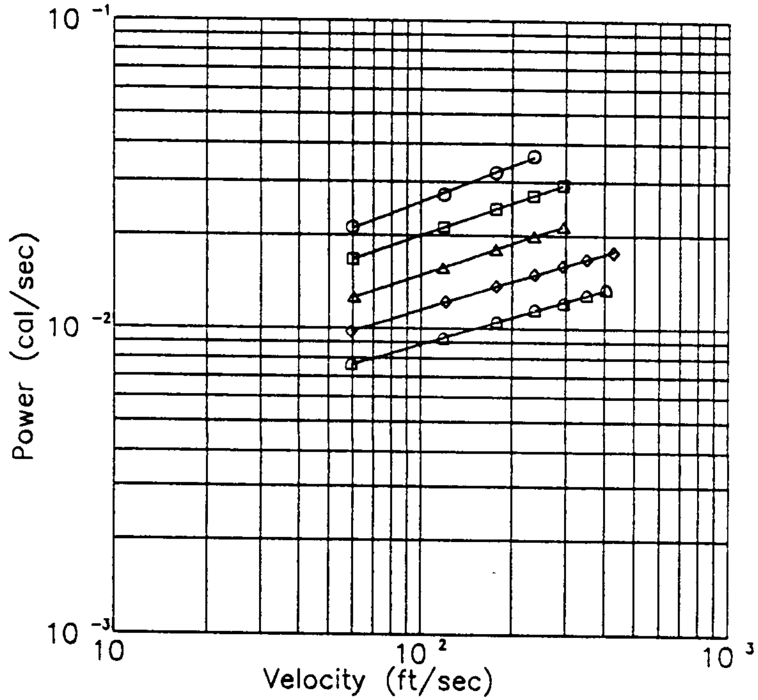

Figure 4.7 Velocity vs. Power
To = 120 F, Dw = 0.00015 inch, P–wire
(Data corrected due to Impedance)
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△ 2.00 Atmosphere; □ 4.00 Atmosphere;
○ 8.00 Atmosphere;

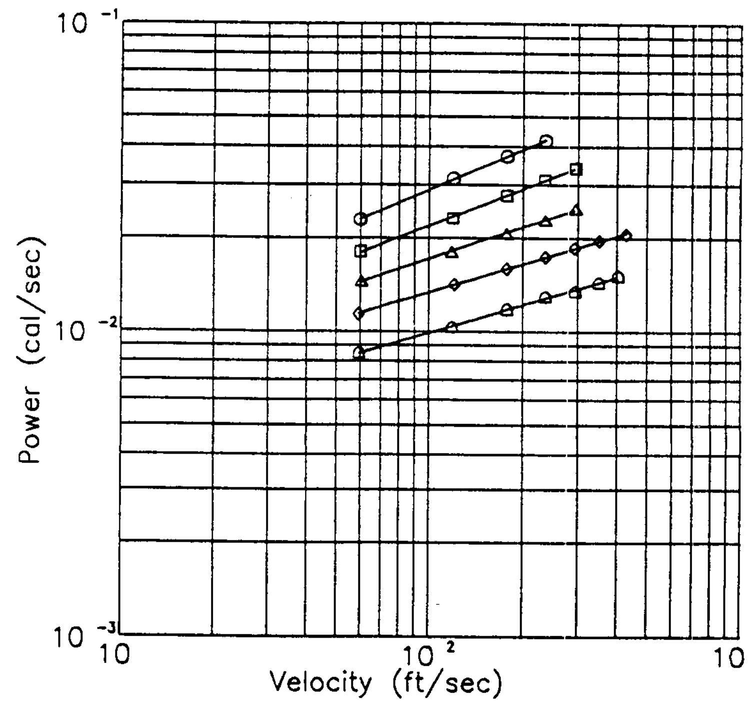

Figure 4.8 Velocity vs. Power
To = 120 F, Dw = 0.00032 inch, P–wire
(Data corrected due to Impedance)
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△ 2.00 Atmosphere; □ 4.00 Atmosphere;
○ 8.00 Atmosphere;

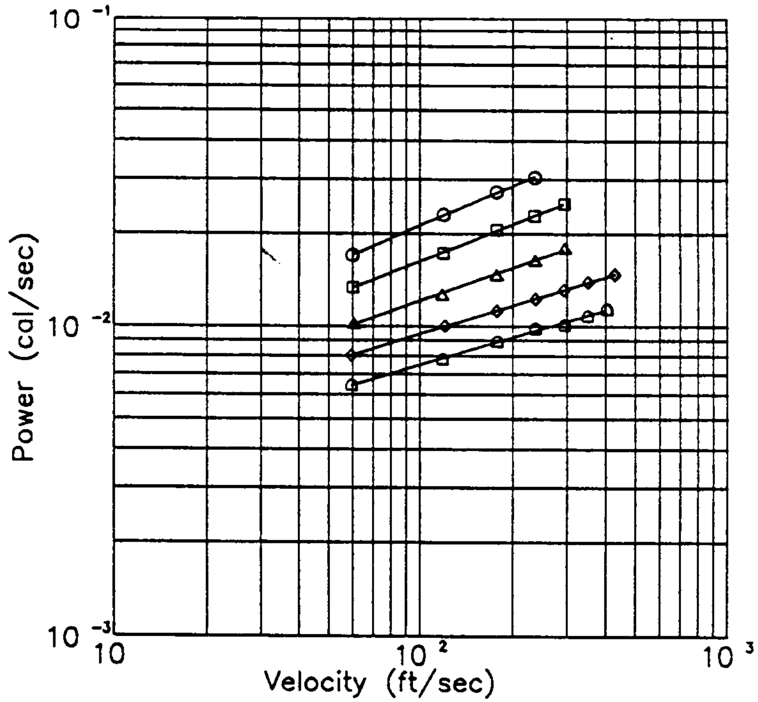

Figure 4.9 Velocity vs. Power
To = 120 F, Dw = 0.00050 inch, P–wire
(Data corrected due to Impedance)
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△ 2.00 Atmosphere; □ 4.00 Atmosphere;
○ 8.00 Atmosphere;

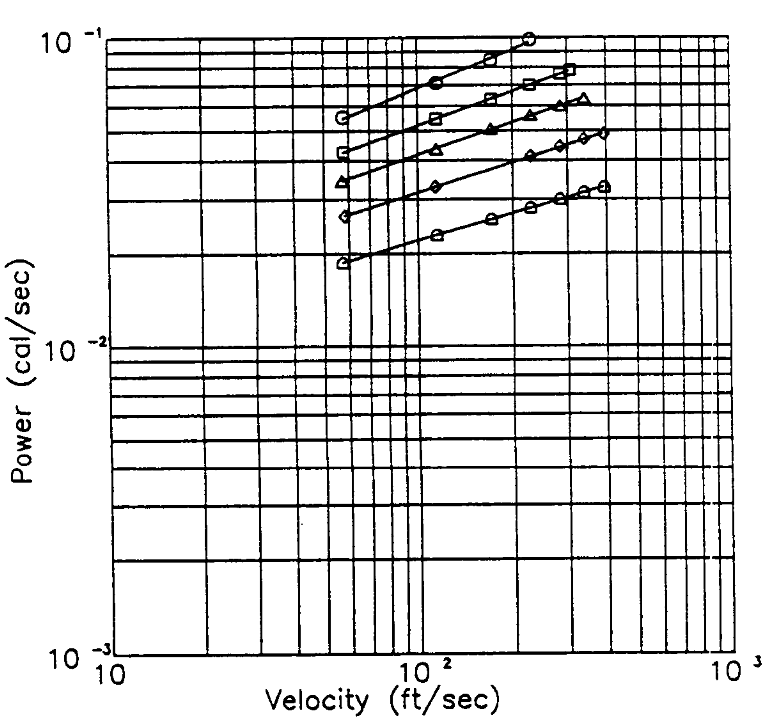

Figure 5.1 Velocity vs. Power
To = 80 F, Dw = 0.00015 inch, Y–wire
Symbols: ◻ 0.50 Atmosphere; ◇ 1.00 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

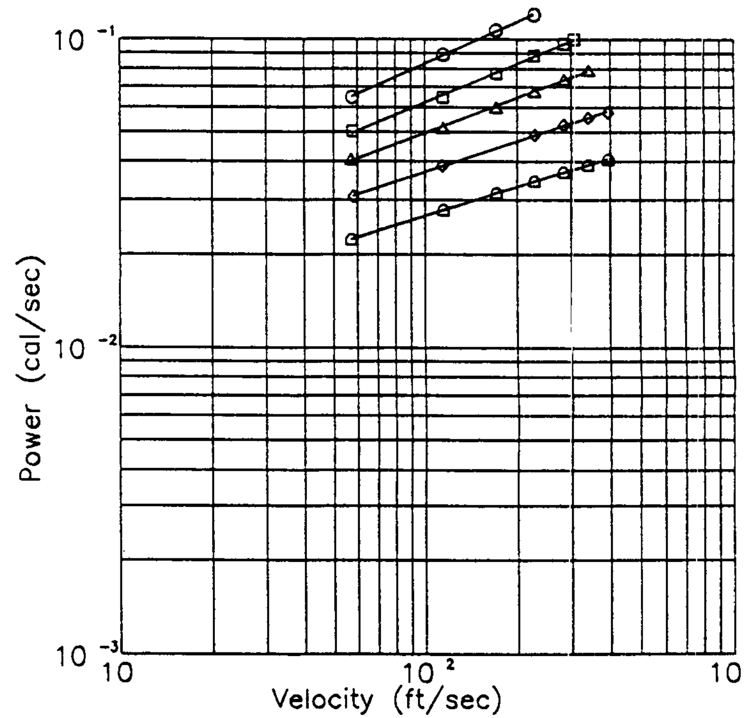

Figure 5.2 Velocity vs. Power
To = 80 F, Dw = 0.00032 inch, Y–wire
Symbols: ◻ 0.50 Atmosphere; ◇ 1.00 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

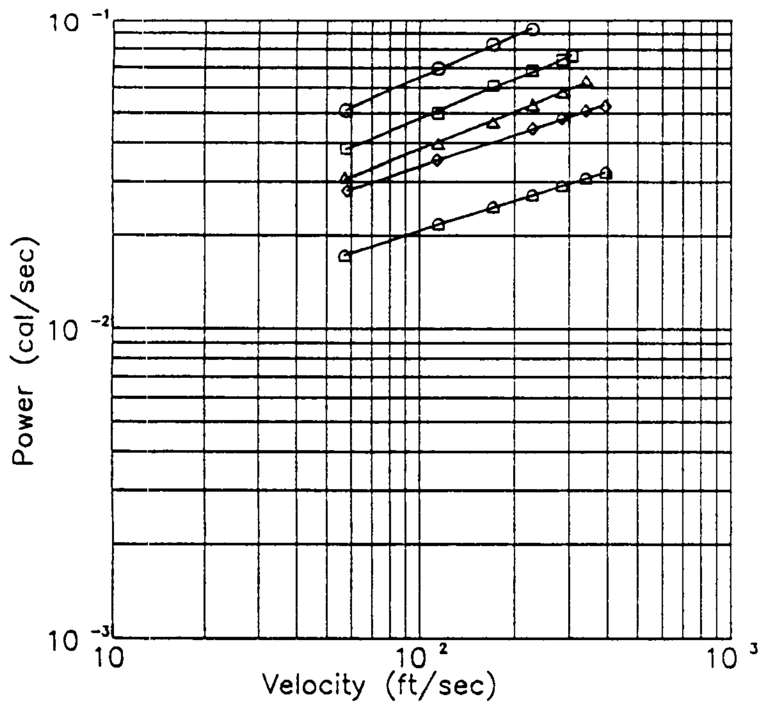

Figure 5.3 Velocity vs. Power
To = 80 F, Dw = 0.00050 inch, Y-wire
Symbols: ◇ 0.50 Atmosphere; ◇ 1.00 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

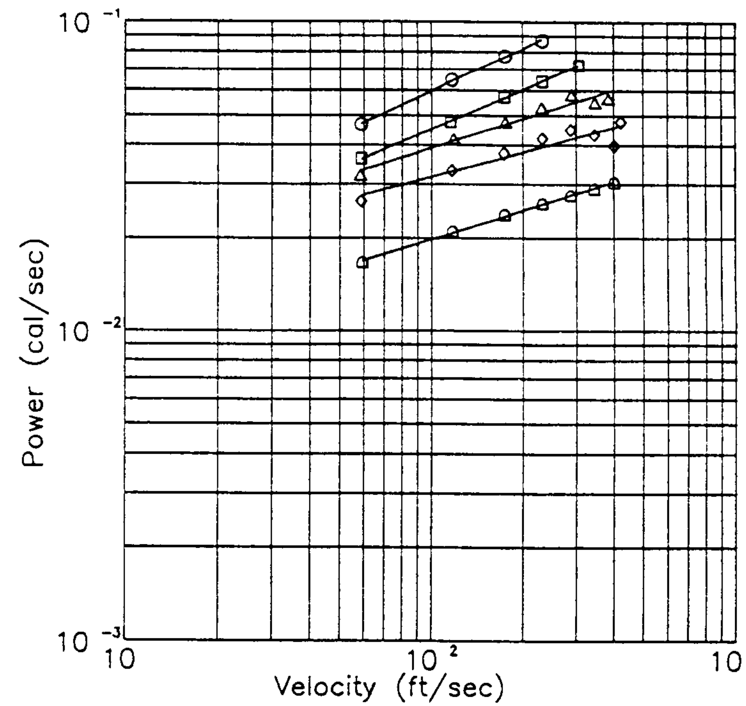

Figure 5.4 Velocity vs. Power
To = 100 F, Dw = 0.00015 inch, Y-wire
Symbols: ◇ 0.50 Atmosphere; ◇ 1.00 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

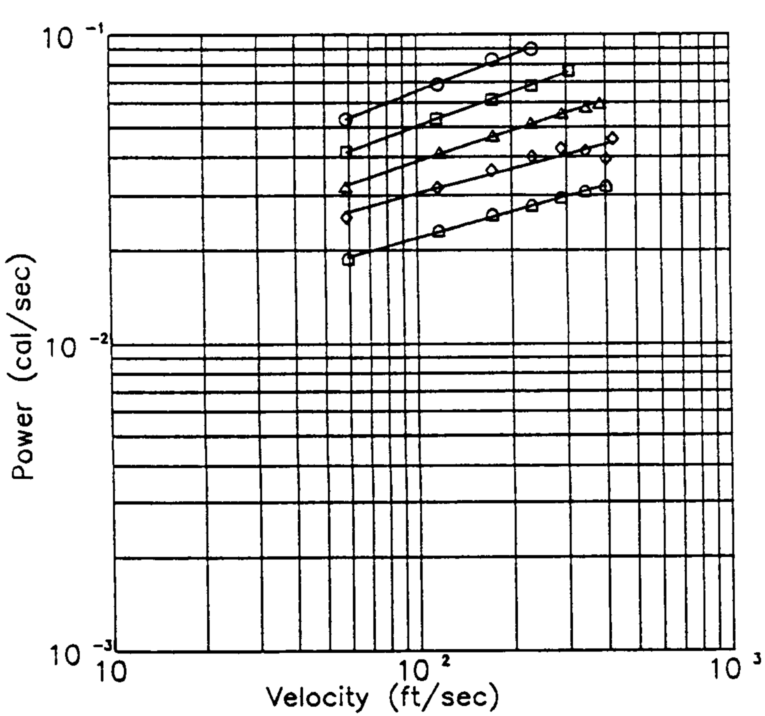

Figure 5.5 Velocity vs. Power
To = 100 F, Dw = 0.00032 inch, Y-wire
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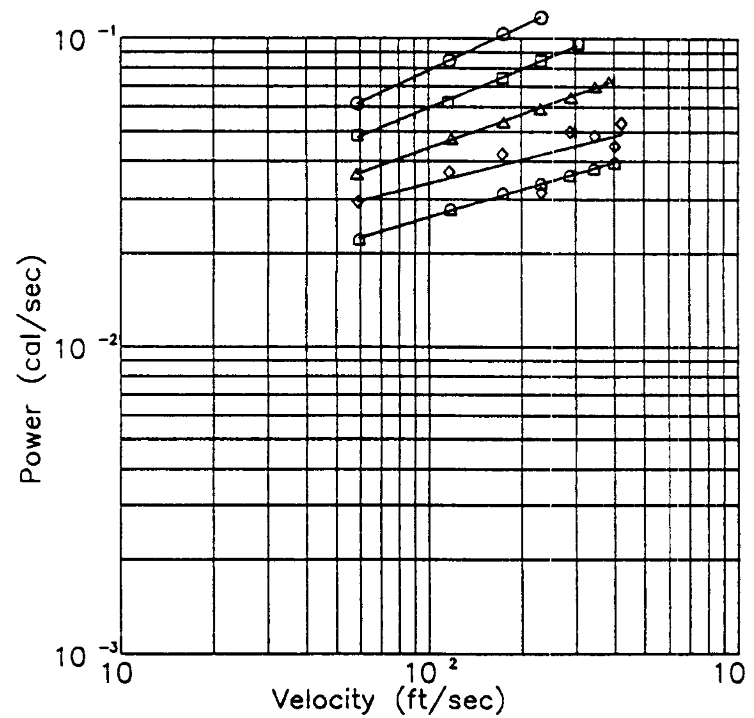

Figure 5.6 Velocity vs. Power
To = 100 F, Dw = 0.00050 inch, Y-wire
Symbols: ◇ 0.50 Atmosphere; ◇ 1.00 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

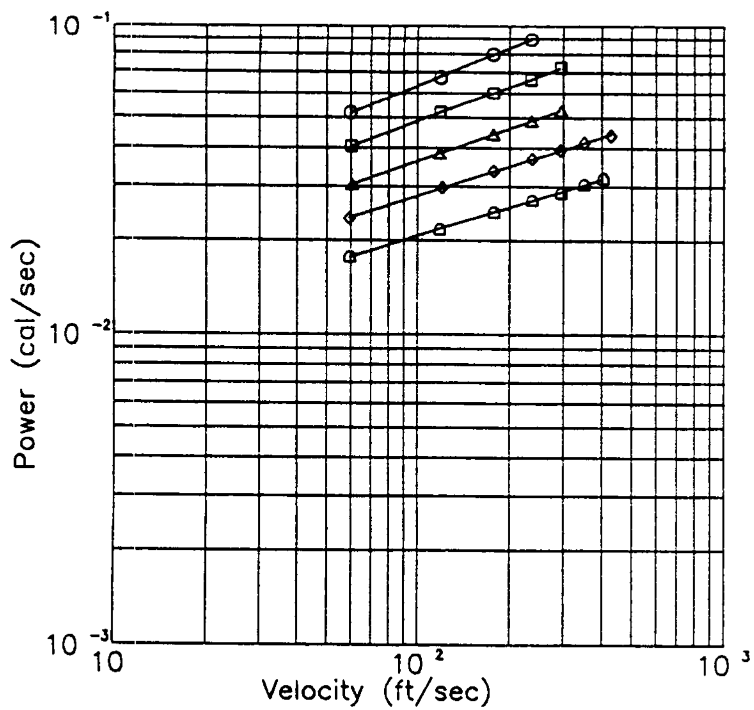

Figure 5.7 Velocity vs. Power
To = 120 F, Dw = 0.00015 inch, Y-wire
Symbols: ◻ 0.50 Atmosphere; ◇ 1.00 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

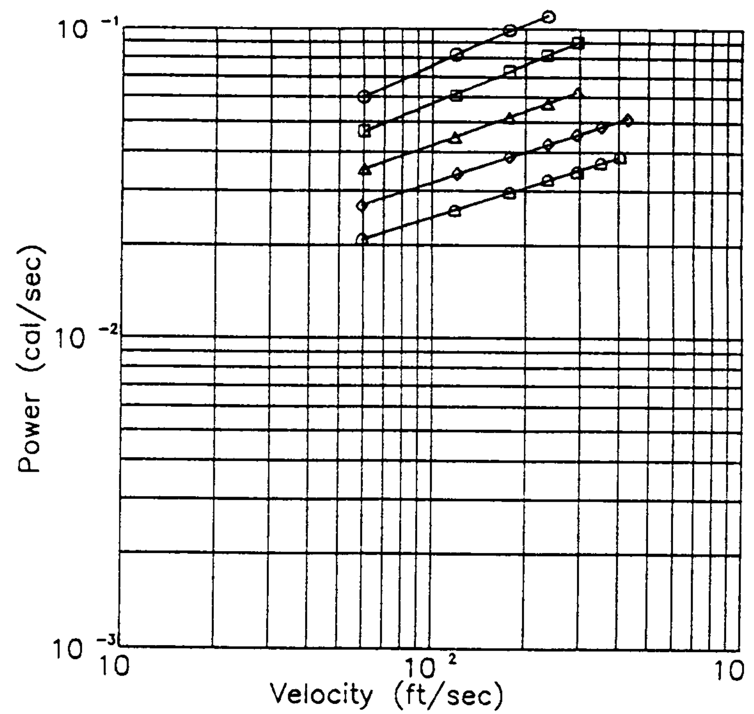

Figure 5.8 Velocity vs. Power
To = 120 F, Dw = 0.00032 inch, Y-wire
Symbols: ◻ 0.50 Atmosphere; ◇ 1.00 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

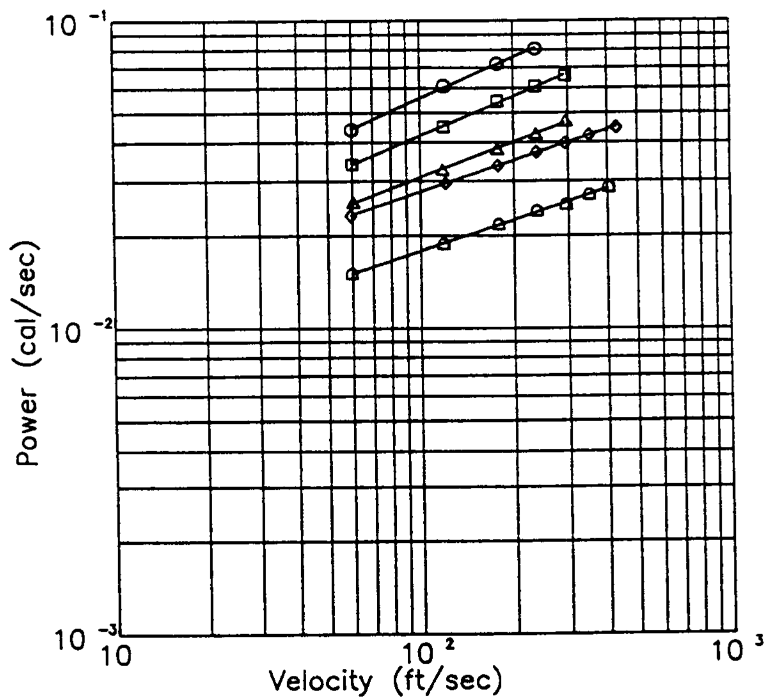

Figure 5.9 Velocity vs. Power
To = 120 F, Dw = 0.00050 inch, Y-wire

Symbols: ⌂ 0.50 Atmosphere; ◇ 1.00 Atmosphere;
△ 2.00 Atmosphere; □ 4.00 Atmosphere;
○ 8.00 Atmosphere;

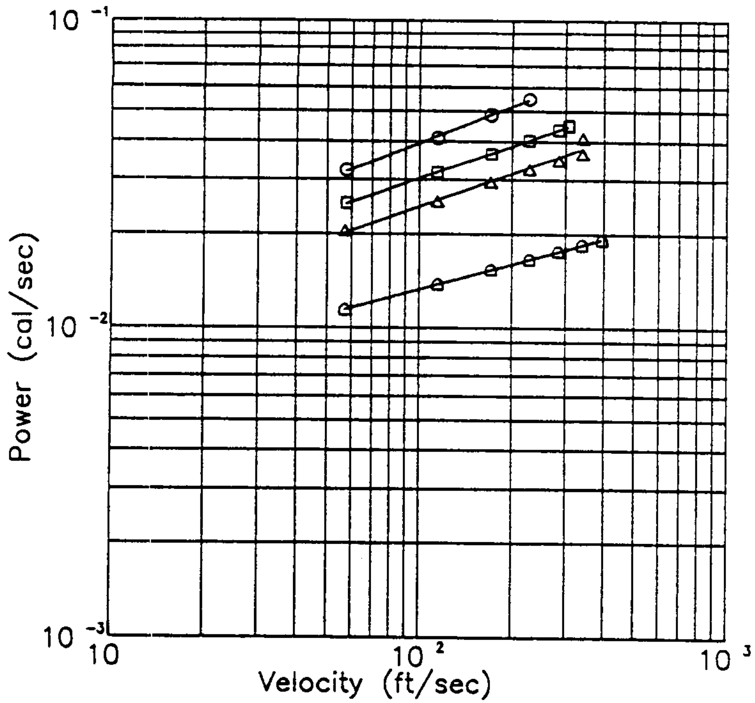

Figure 6.1 Velocity vs. Power
To = 80 F, Dw = 0.00015 inch, S–wire
Symbols: ⌂ 0.50 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

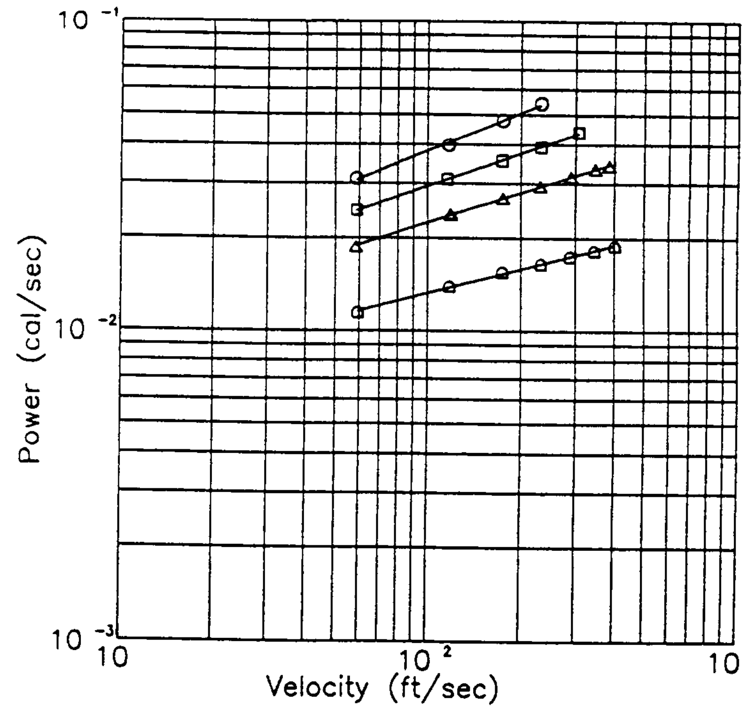

Figure 6.2 Velocity vs. Power
To = 100 F, Dw = 0.00015 inch, S–wire
Symbols: ⌂ 0.50 Atmosphere; △ 2.00 Atmosphere; □ 4.00 Atmosphere; ○ 8.00 Atmosphere;

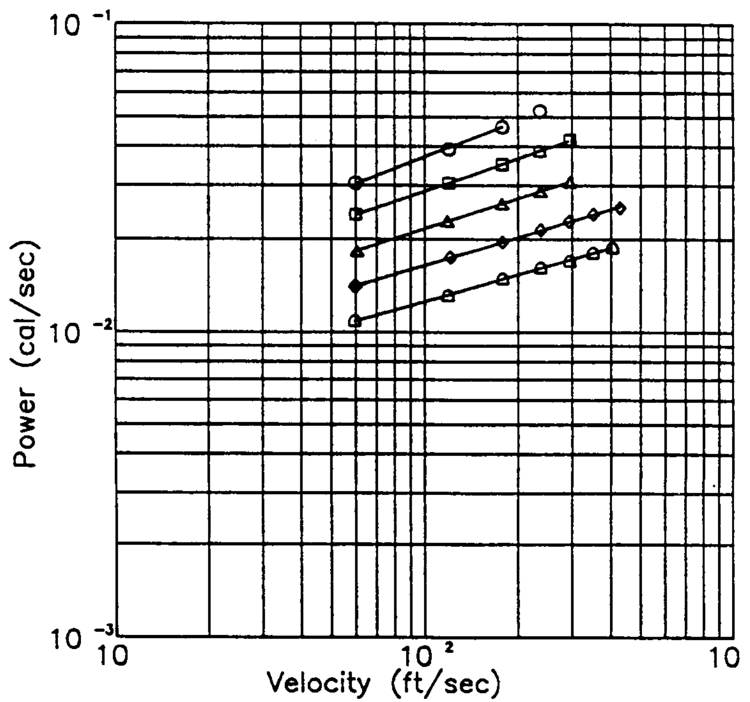

Figure 6.3 Velocity vs. Power
To = 120 F, Dw = 0.00015 inch, S-wire
Symbols: ⌂ 0.50 Atmosphere; ◇ 1.00 Atmosphere;
△ 2.00 Atmosphere; □ 4.00 Atmosphere;
○ 8.00 Atmosphere;

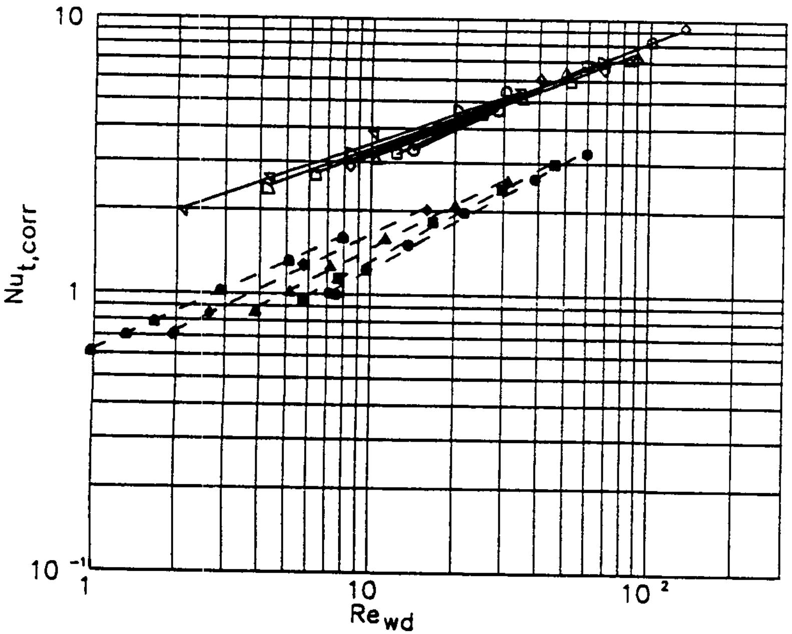

Figure 7.1 Nusselt Number vs. Reynolds Number
To = 80 F, Dw = 0.00015 inch, P–wire
(Data corrected due to impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
D	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

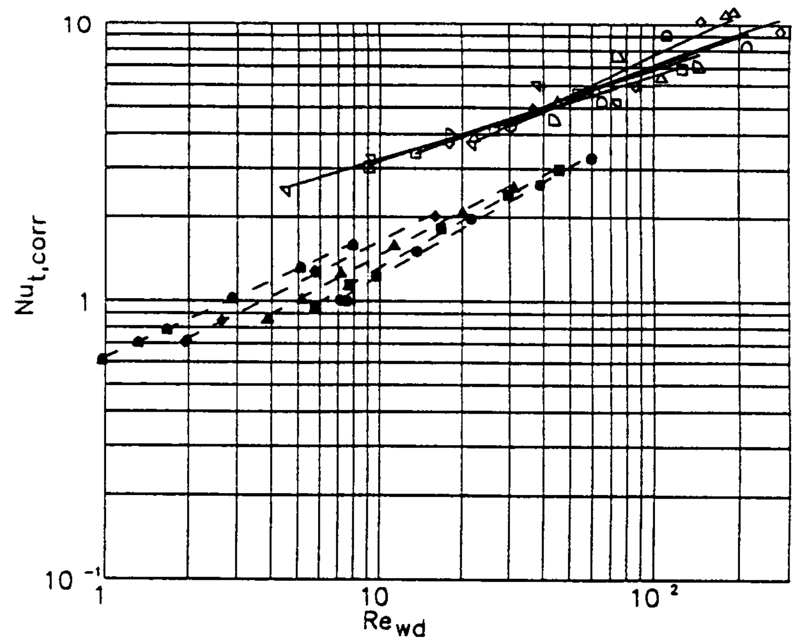

Figure 7.2 Nusselt Number vs. Reynolds Number
To = 80 F, Dw = 0.00032 inch, P–wire
(Data corrected due to impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
D	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

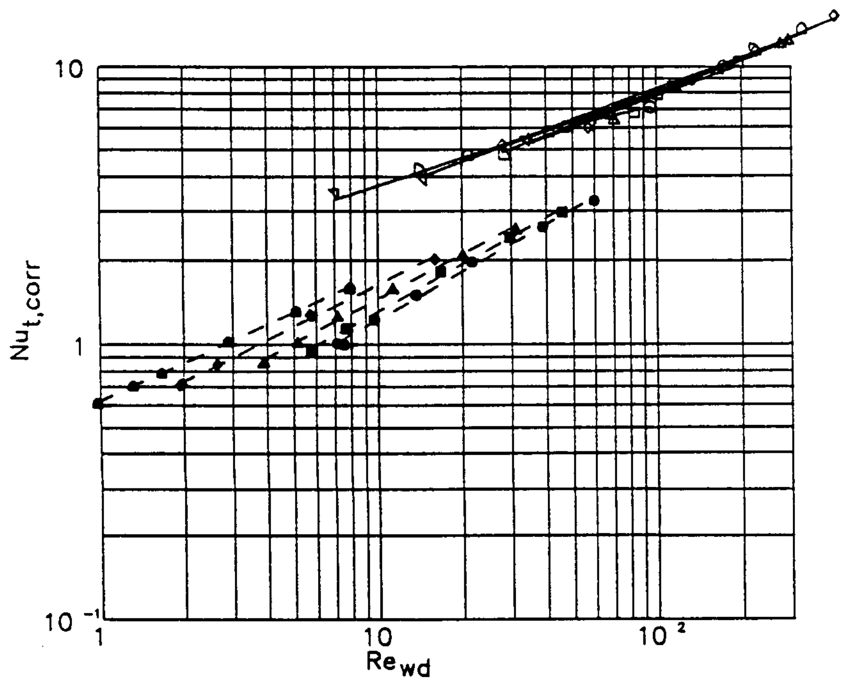

Figure 7.3 Nusselt Number vs. Reynolds Number
To = 80 F, Dw = 0.00050 inch, P–wire
(Data corrected due to impedance)

Symbols:

Present	Baldwin	Mach No.
▽	●	0.05
◿	◆	0.10
⌓		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

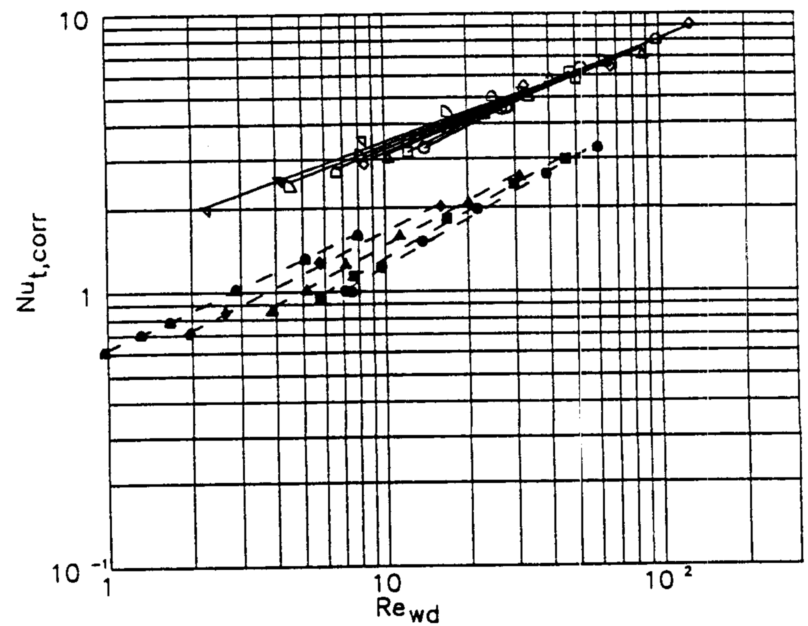

Figure 7.4 Nusselt Number vs. Reynolds Number
To = 100 F, Dw = 0.00015 inch, P–wire
(Data corrected due to impedance)

Symbols:

Present	Baldwin	Mach No.
▽	●	0.05
◿	◆	0.10
⌓		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

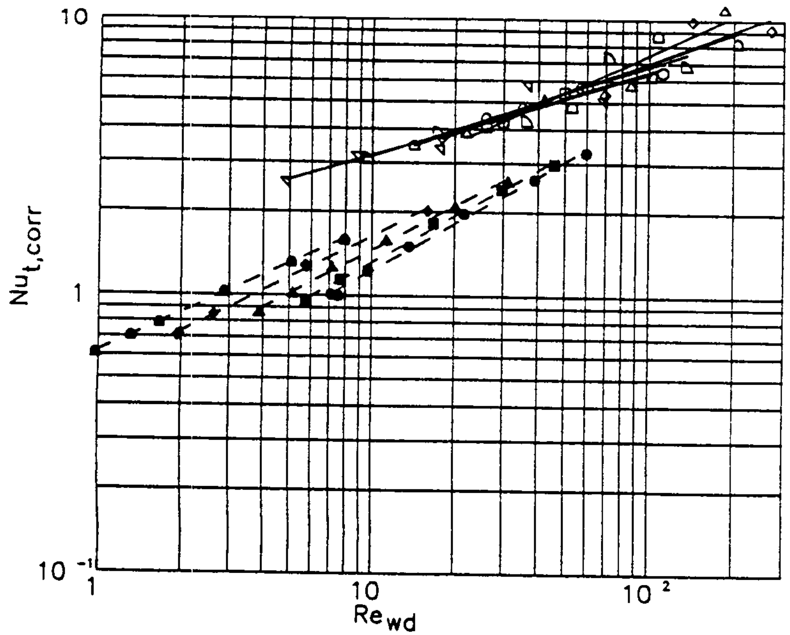

Figure 7.5 Nusselt Number vs. Reynolds Number
To = 100 F, Dw = 0.00032 inch, P–wire
(Data corrected due to impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
D	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

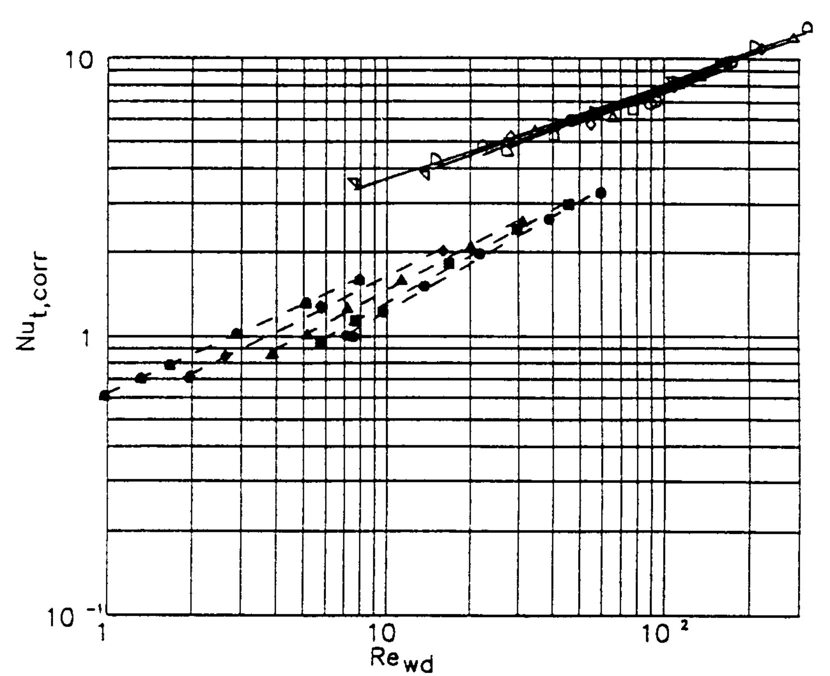

Figure 7.6 Nusselt Number vs. Reynolds Number
To = 100 F, Dw = 0.00050 inch, P–wire
(Data corrected due to impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
D	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

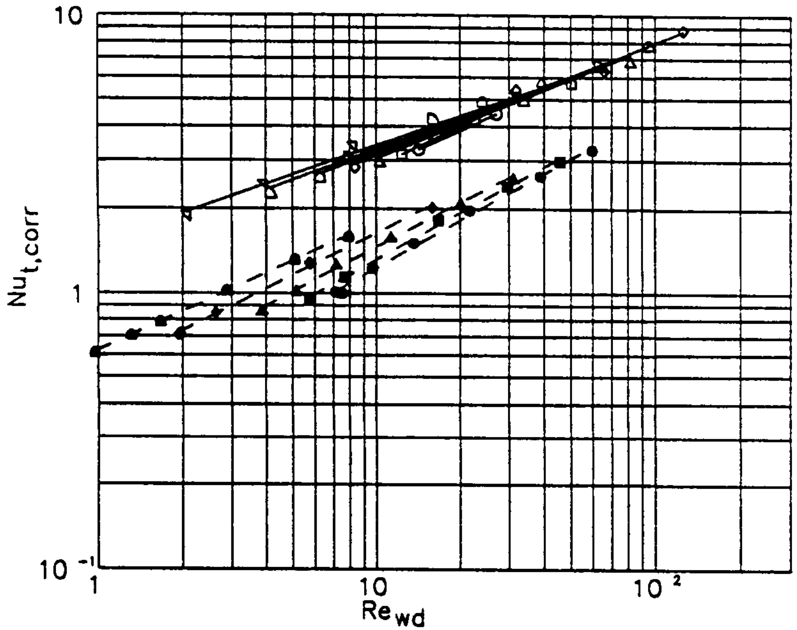

Figure 7.7 Nusselt Number vs. Reynolds Number
To = 120 F, Dw = 0.00015 inch, P–wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
▽	⬟	0.05
◺	◆	0.10
⌂		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

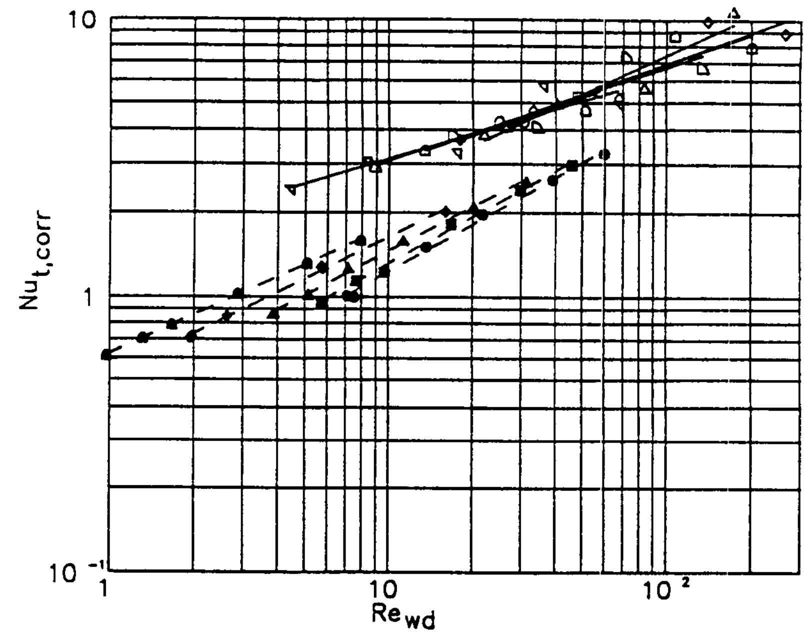

Figure 7.8 Nusselt Number vs. Reynolds Number
To = 120 F, Dw = 0.00032 inch, P–wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
▽	⬟	0.05
◺	◆	0.10
⌂		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

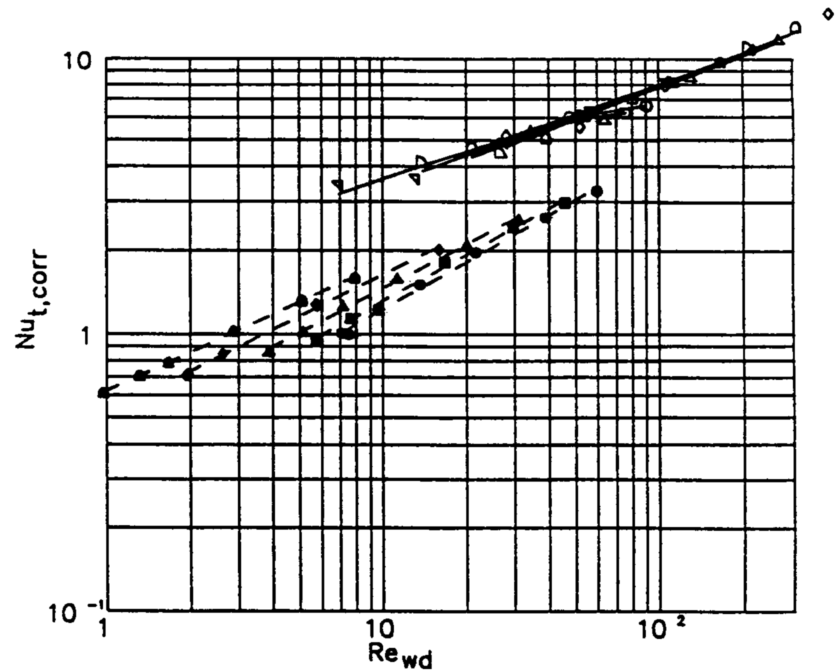

Figure 7.9 Nusselt Number vs. Reynolds Number
To = 120 F, Dw = 0.00050 inch, P–wire
(Data corrected due to impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
◇		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

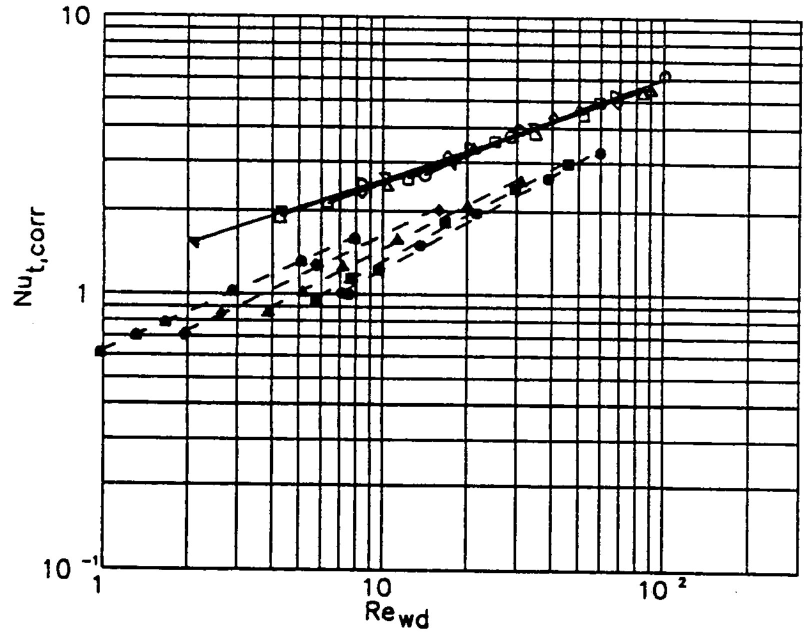

Figure 8.1 Nusselt Number vs. Reynolds Number
To = 80 F, Dw = 0.00015 inch, Y-wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

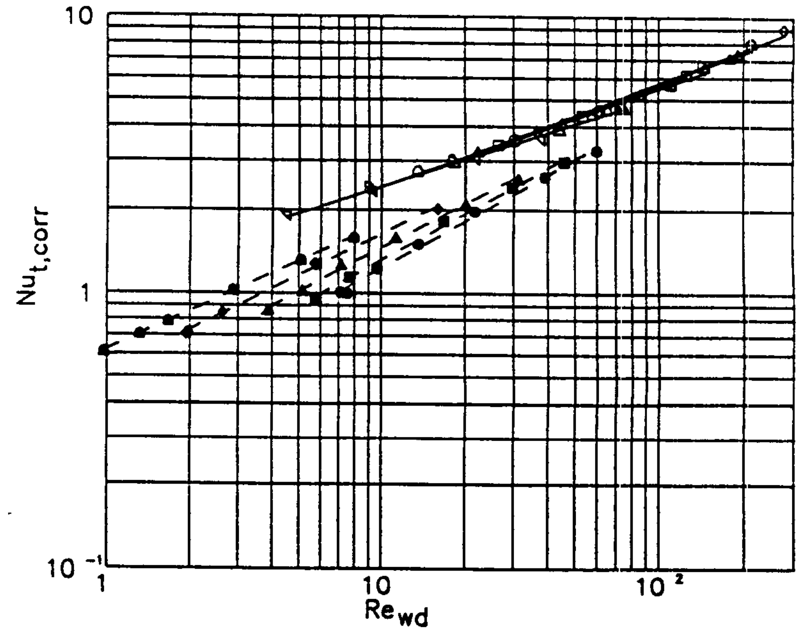

Figure 8.2 Nusselt Number vs. Reynolds Number
To = 80 F, Dw = 0.00032 inch, Y-wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

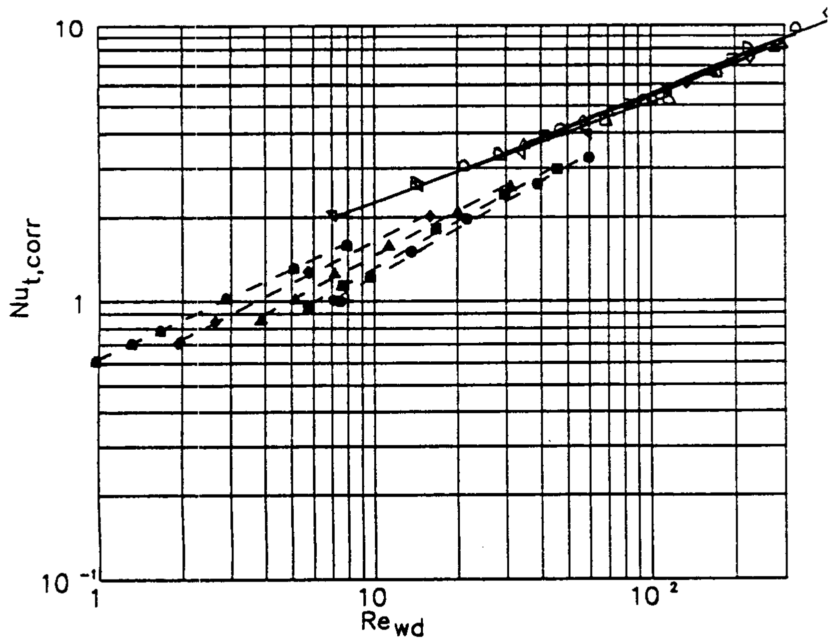

Figure 8.3 Nusselt Number vs. Reynolds Number
To = 80 F, Dw = 0.00050 inch, Y–wire

Symbols:

Present	Baldwin	Mach No.
◁	◓	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

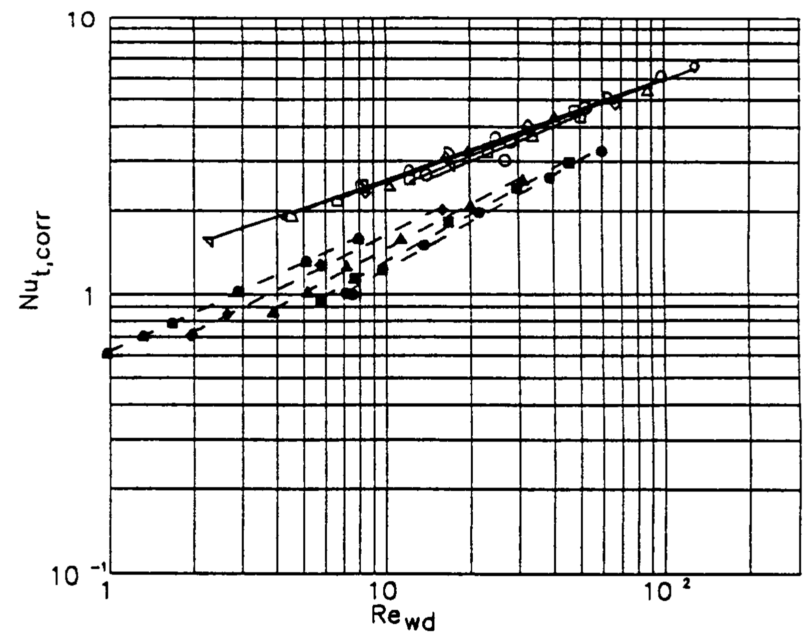

Figure 8.4 Nusselt Number vs. Reynolds Number
To =100 F, Dw = 0.00015 inch, Y–wire

Symbols:

Present	Baldwin	Mach No.
◁	◓	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

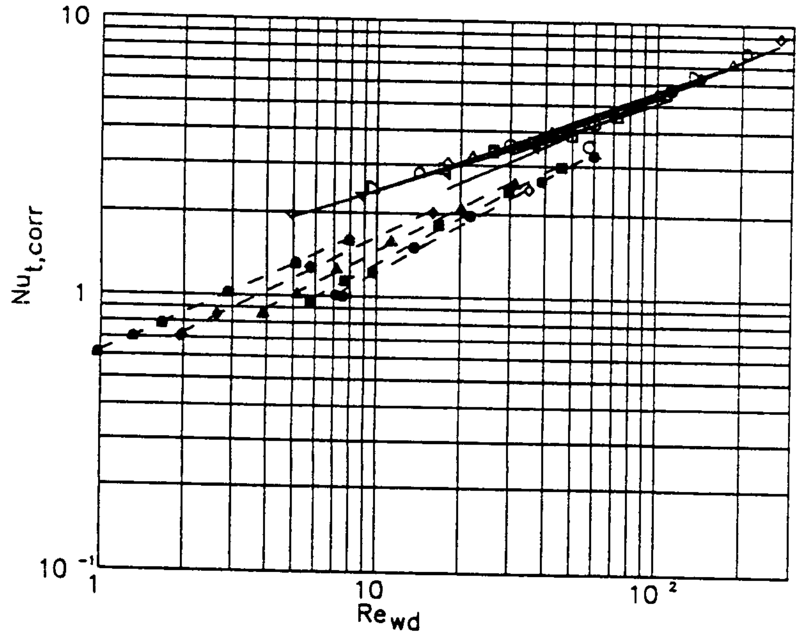

Figure 8.5 Nusselt Number vs. Reynolds Number
To =100 F, Dw = 0.00032 inch, Y–wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
▷		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

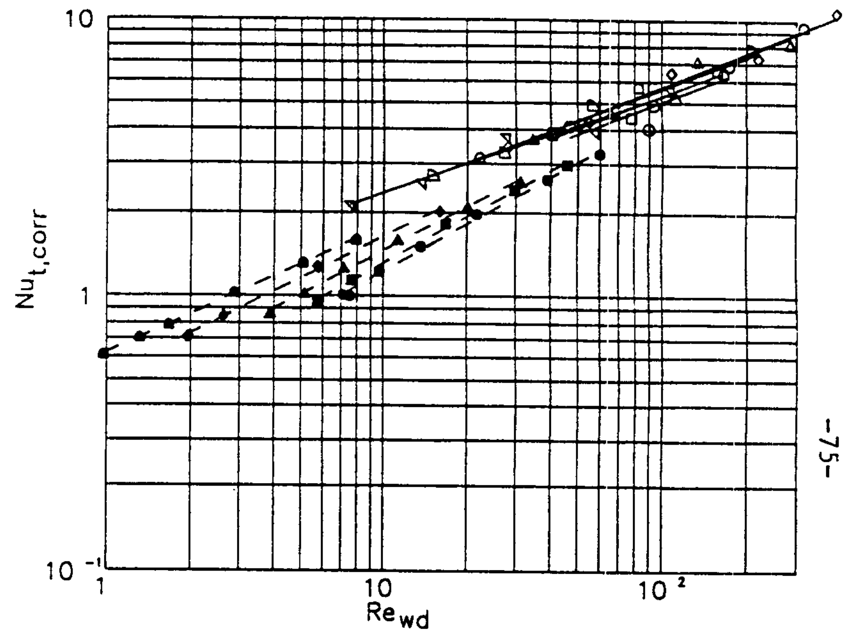

Figure 8.6 Nusselt Number vs. Reynolds Number
To = 100 F, Dw = 0.00050 inch, Y–wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
▷		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

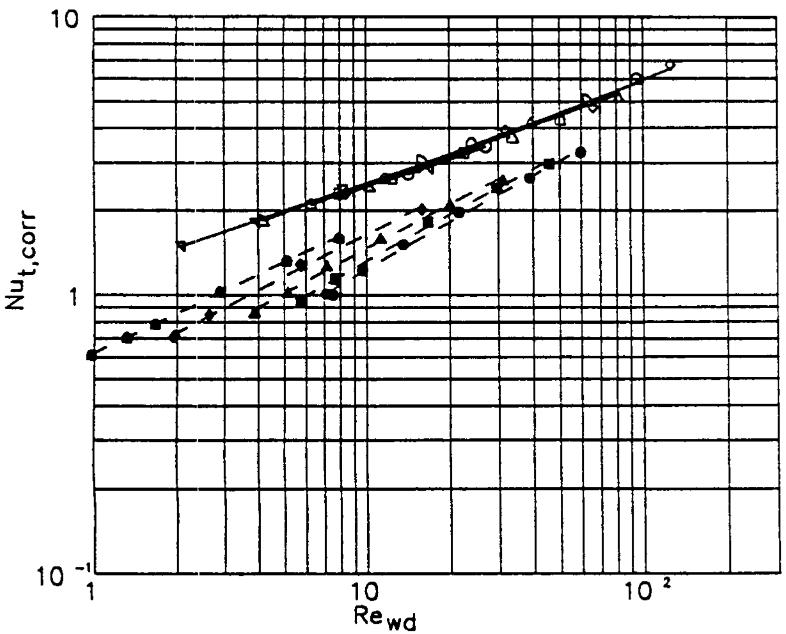

Figure 8.7 Nusselt Number vs. Reynolds Number
To =120 F, Dw = 0.00015 inch, Y-wire

Symbols:

Present	Baldwin	Mach No.
▽	⬟	0.05
◁	◆	0.10
▷		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

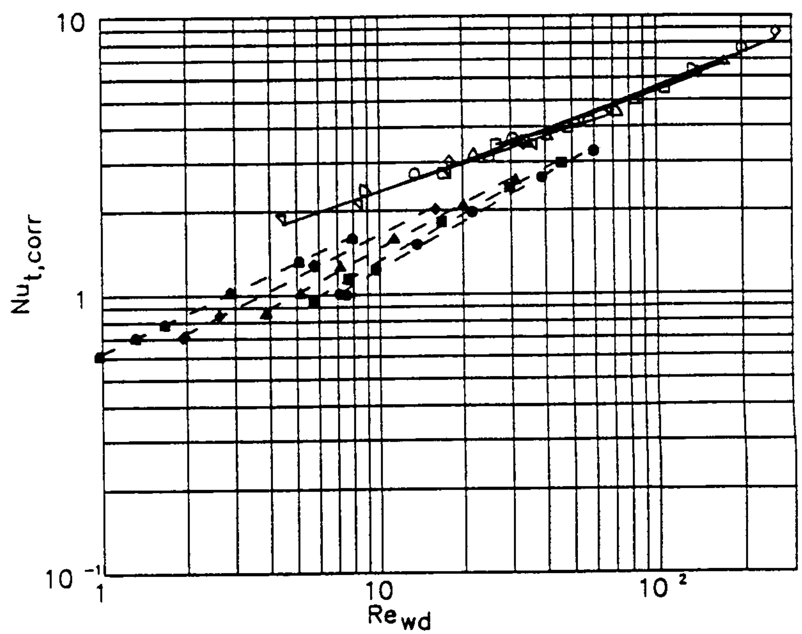

Figure 8.8 Nusselt Number vs. Reynolds Number
To =120 F, Dw = 0.00032 inch, Y-wire

Symbols:

Present	Baldwin	Mach No.
▽	⬟	0.05
◁	◆	0.10
▷		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

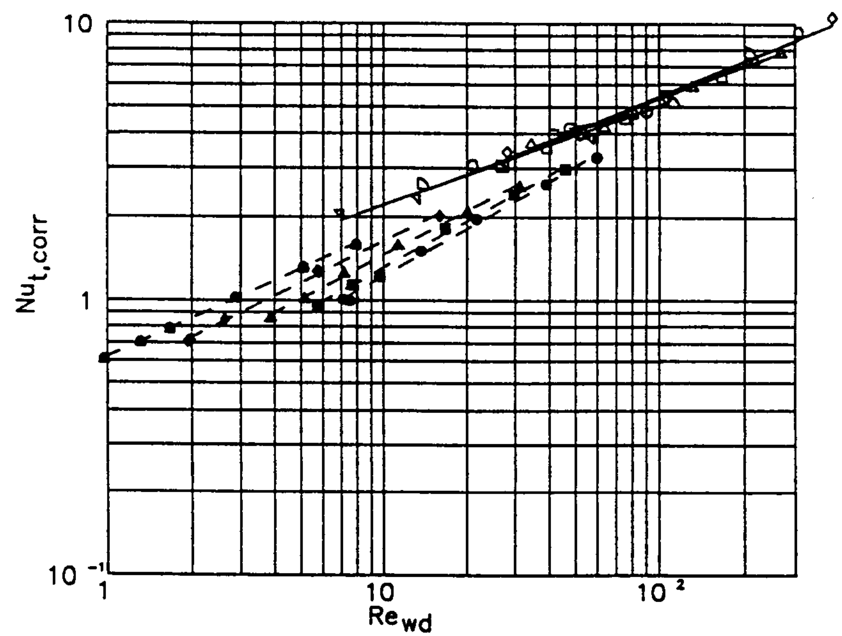

Figure 8.9 Nusselt Number vs. Reynolds Number
To = 120 F, Dw = 0.00050 inch, Y-wire

Symbols:

Present	Baldwin	Mach No.
▽	⬟	0.05
◁	◆	0.10
◁		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

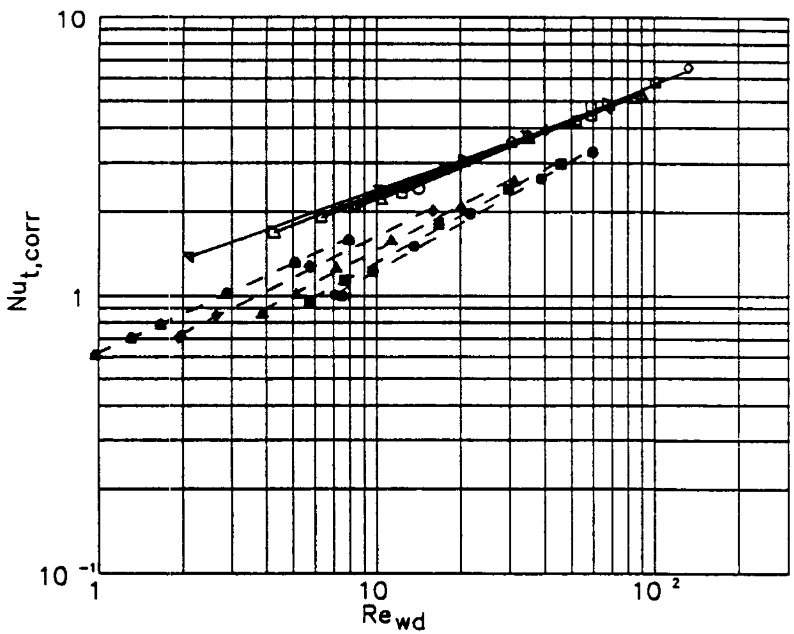

Figure 9.1 Nusselt Number vs. Reynolds Number
To = 80 F, Dw = 0.00015 inch, Single wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
◻		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

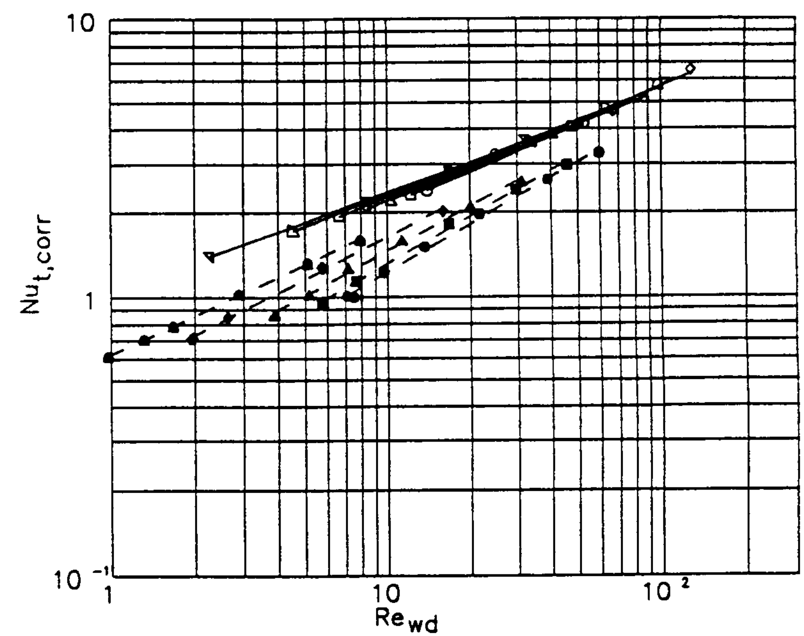

Figure 9.2 Nusselt Number vs. Reynolds Number
To = 100 F, Dw = 0.00015 inch, Single wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
◻		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

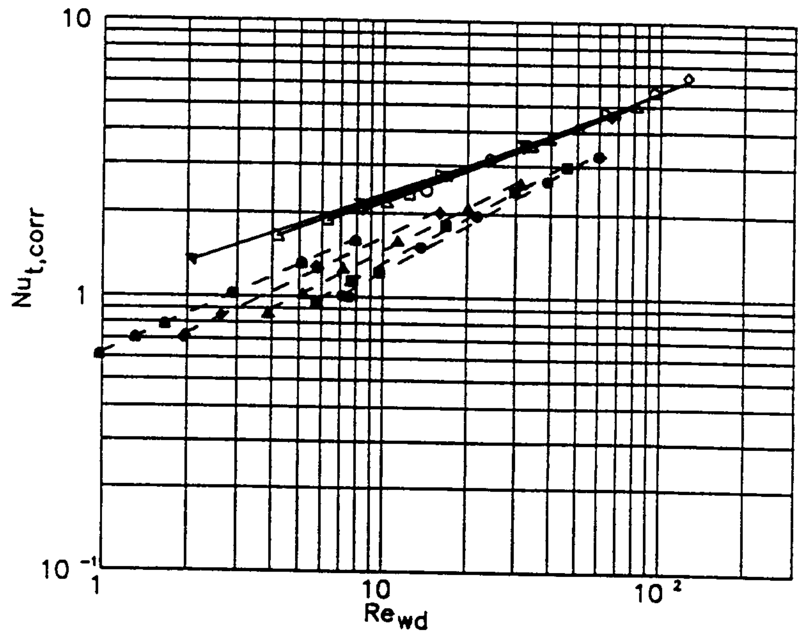

Figure 9.3 Nusselt Number vs. Reynolds Number
To = 120 F, Dw = 0.00015 inch, Single wire

Symbols:

Present	Baldwin	Mach No.
◁	⬟	0.05
▷	◆	0.10
▽		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

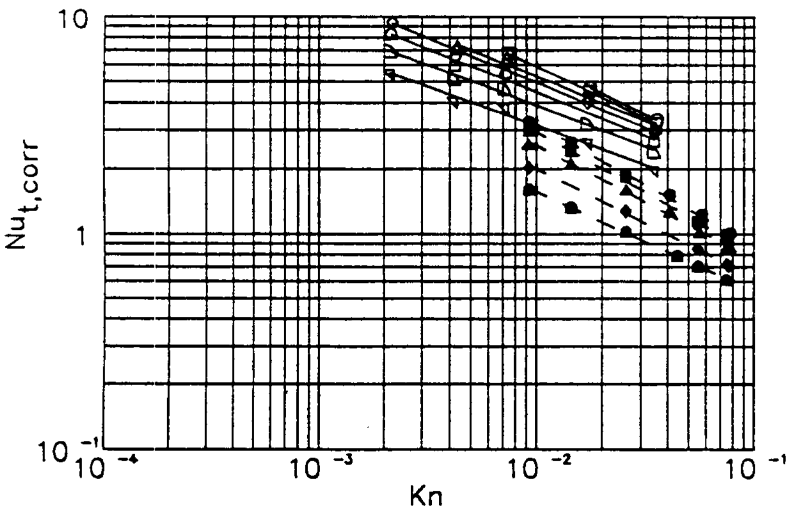

Figure 10.1 Nusselt Number vs. Knudsen Number
To = 80 F, dw = 0.00015 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
▽		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

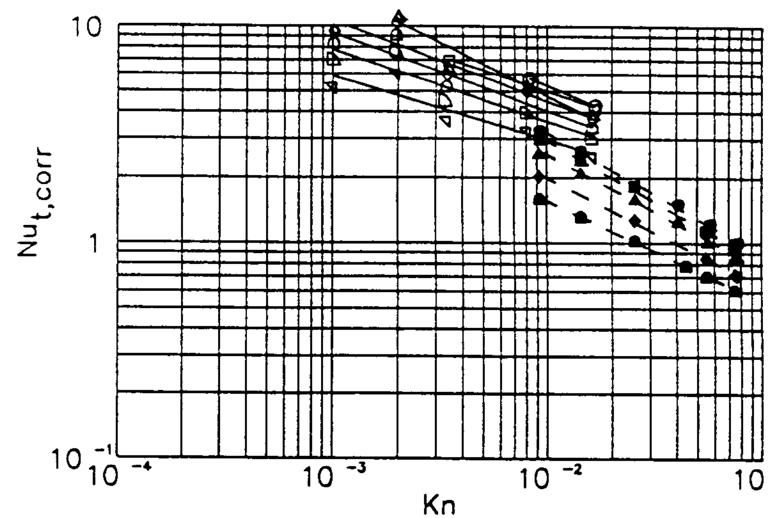

Figure 10.2 Nusselt Number vs. Knudsen Number
To = 80 F, dw = 0.00032 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
▽		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

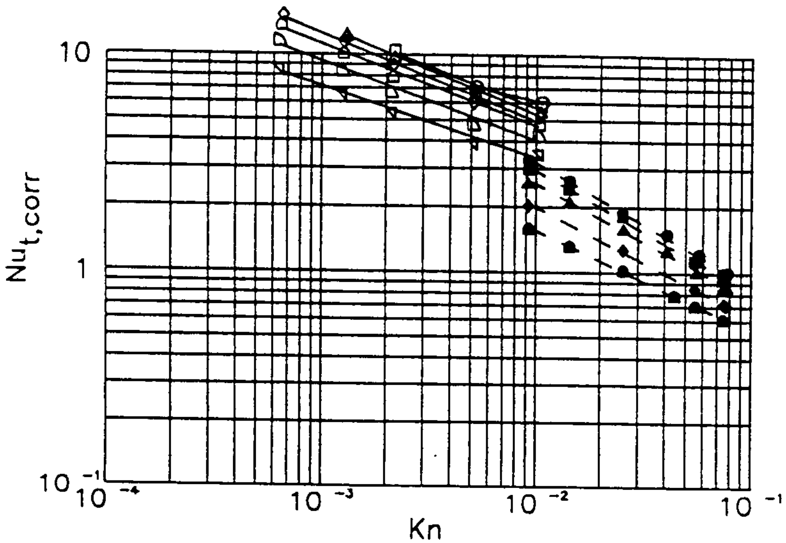

Figure 10.3 Nusselt Number vs. Knudsen Number
To = 80 F, dw = 0.00050 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
◁	⬟	0.05
▷	◆	0.10
⌂		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

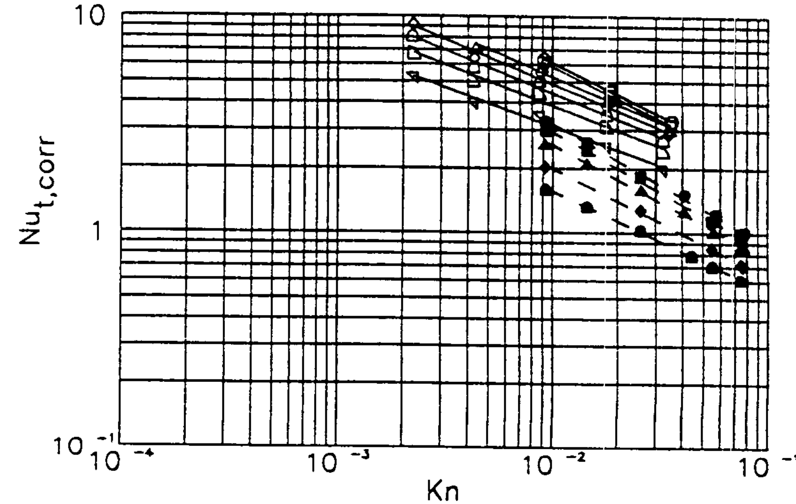

Figure 10.4 Nusselt Number vs. Knudsen Number
To = 100 F, dw = 0.00015 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
◁	⬟	0.05
▷	◆	0.10
⌂		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

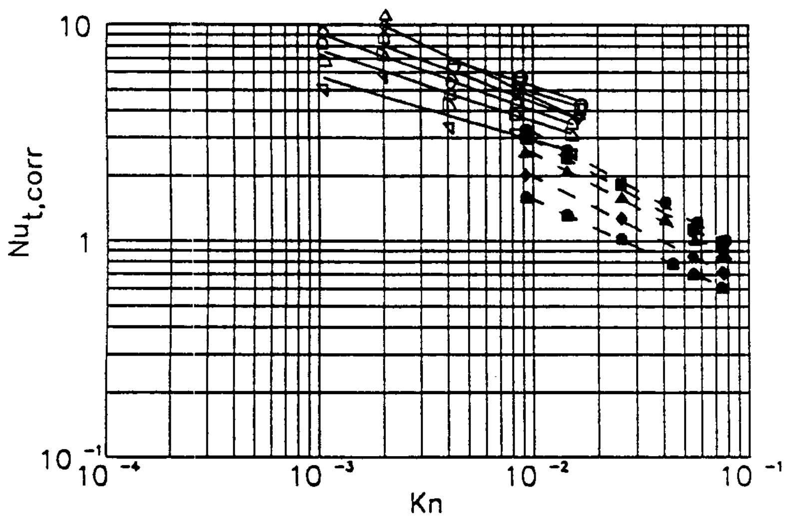

Figure 10.5 Nusselt Number vs. Knudsen Number
To = 100 F, dw = 0.00032 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
◺	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

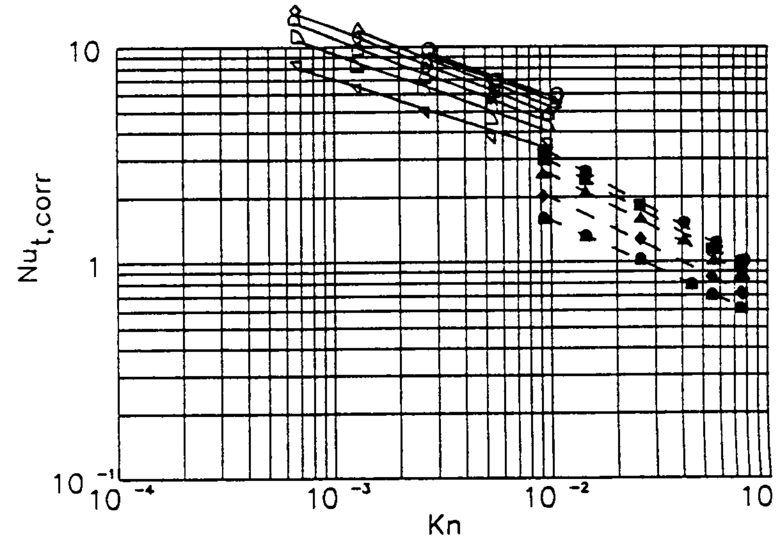

Figure 10.6 Nusselt Number vs. Knudsen Number
To = 100 F, dw = 0.00050 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
◺	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

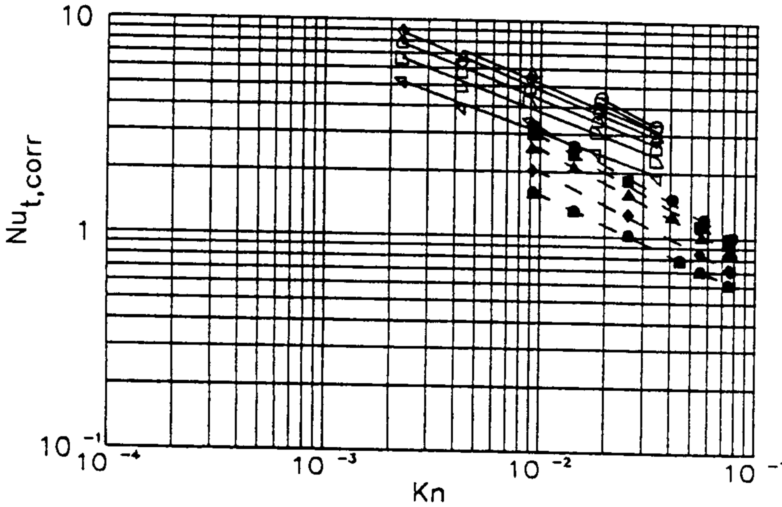

Figure 10.7 Nusselt Number vs. Knudsen Number
To = 120 F, dw = 0.00015 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
◠		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

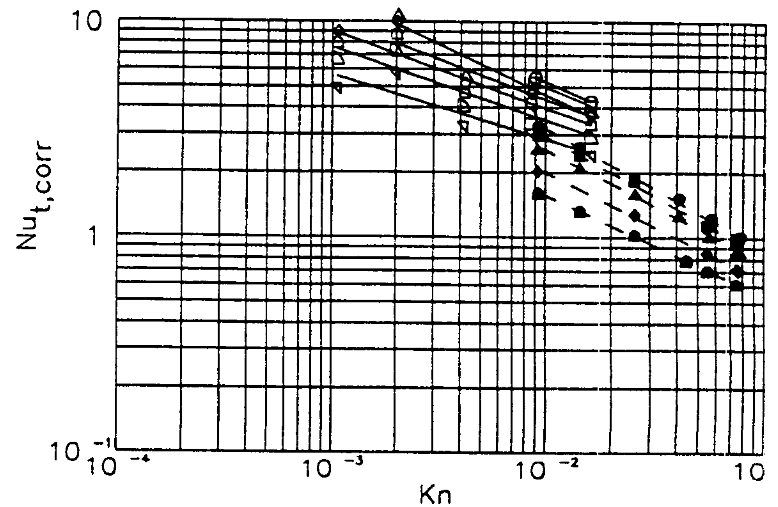

Figure 10.8 Nusselt Number vs. Knudsen Number
To = 120 F, dw = 0.00032 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
◠		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

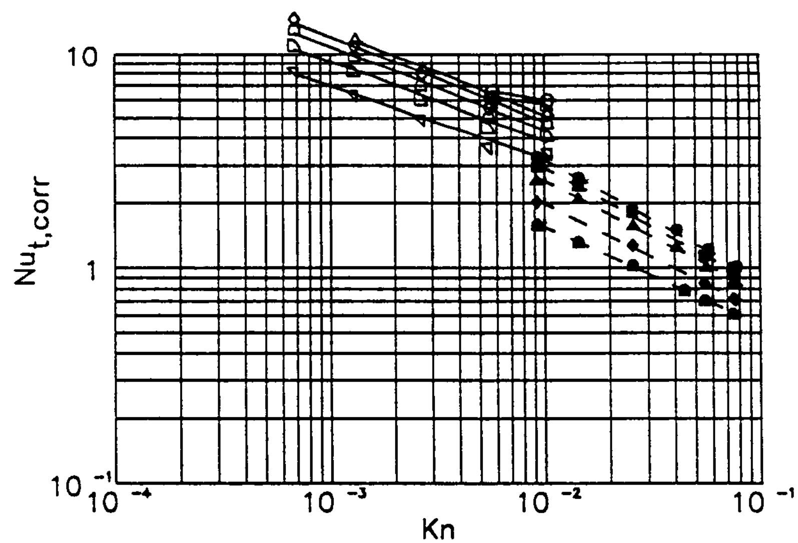

Figure 10.9 Nusselt Number vs. Knudsen Number
To = 120 F, dw = 0.00050 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Baldwin	Mach No.
▽	●	0.05
△	◆	0.10
◁		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

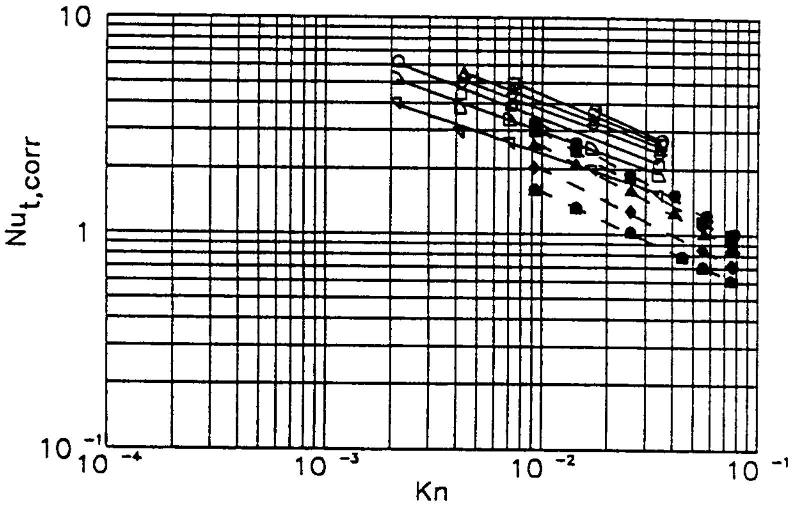

Figure 11.1 Nusselt Number vs. Knudsen Number
To = 80 F, dw = 0.00015 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
▽	●	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

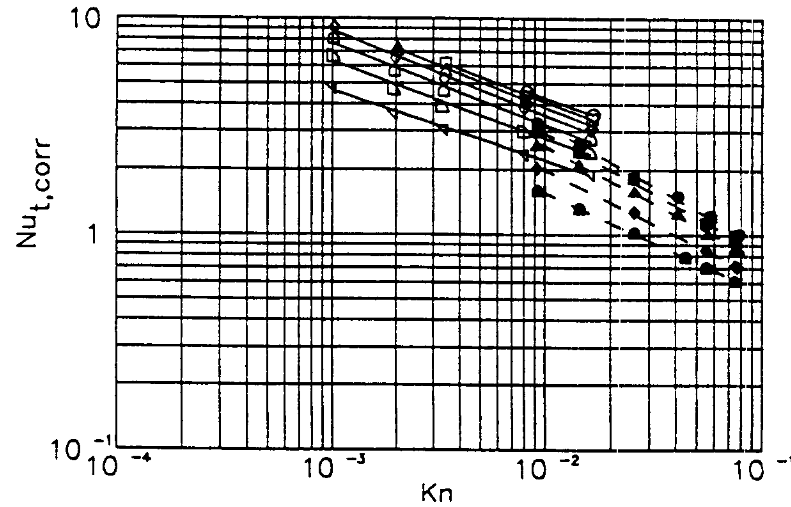

Figure 11.2 Nusselt Number vs. Knudsen Number
To = 80 F, dw = 0.00032 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
▽	●	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

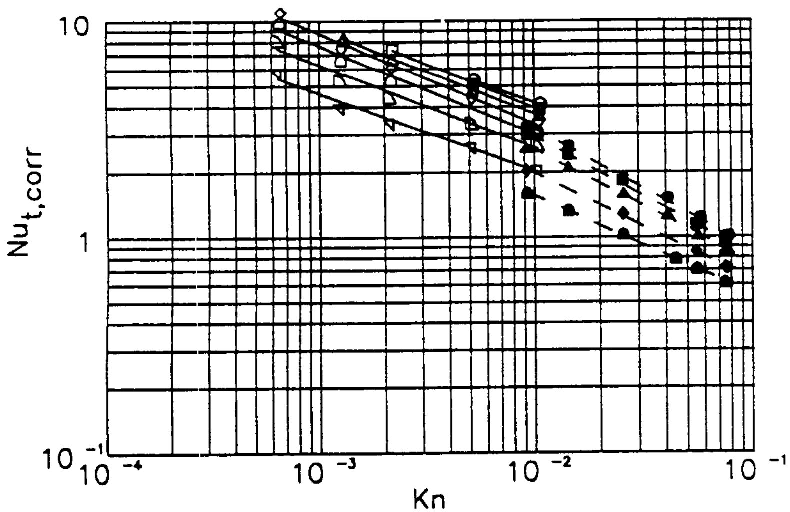

Figure 11.3 Nusselt Number vs. Knudsen Number
To = 80 F, dw = 0.00050 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

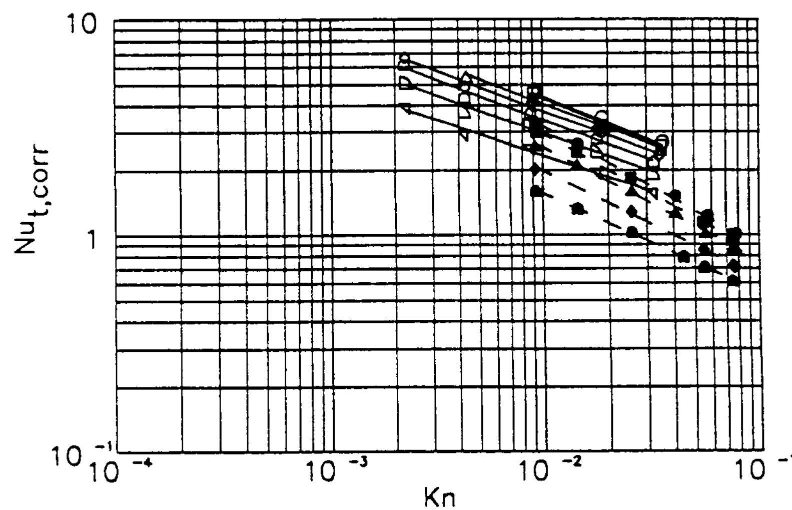

Figure 11.4 Nusselt Number vs. Knudsen Number
To = 100 F, dw = 0.00015 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

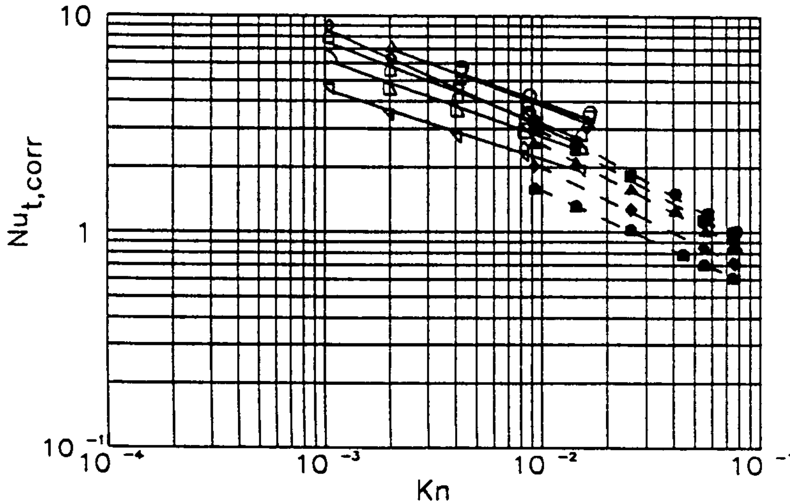

Figure 11.5 Nusselt Number vs. Knudsen Number
To = 100 F, dw = 0.00032 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
◇		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

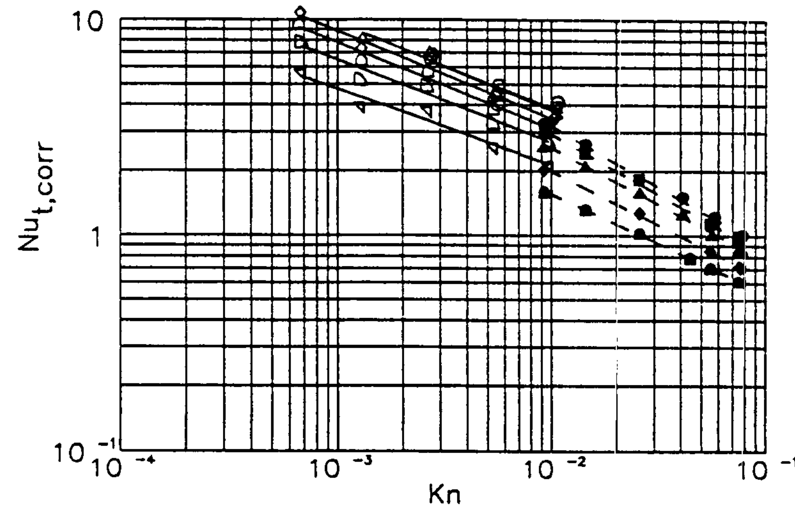

Figure 11.6 Nusselt Number vs. Knudsen Number
To = 100 F, dw = 0.00050 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
◇		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

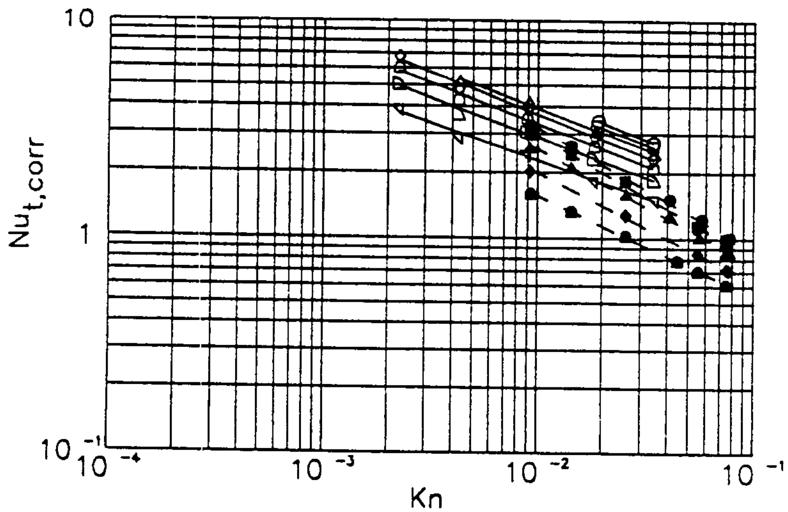

Figure 11.7 Nusselt Number vs. Knudsen Number
To = 120 F, dw = 0.00015 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
▭		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

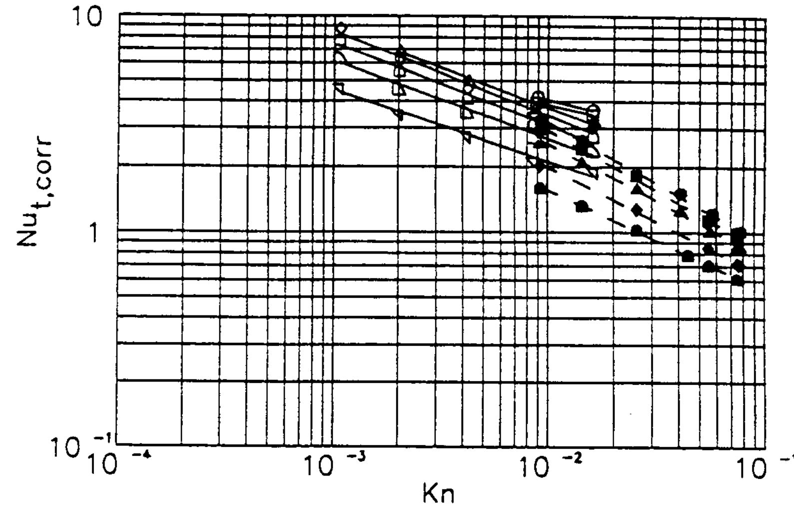

Figure 11.8 Nusselt Number vs. Knudsen Number
To = 120 F, dw = 0.00032 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
▭		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

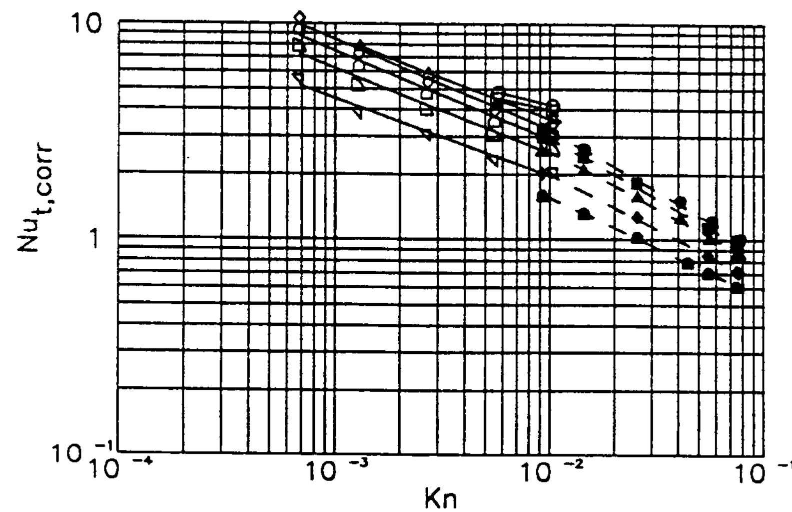

Figure 11.9 Nusselt Number vs. Knudsen Number
To = 120 F, dw = 0.00050 inch, Y – wire

Symbols:

Present	Baldwin	Mach No.
▽	●	0.05
△	◆	0.10
▷		0.15
◇	▲	0.20
◁		0.25
□	■	0.30
○		0.35
	●	0.40

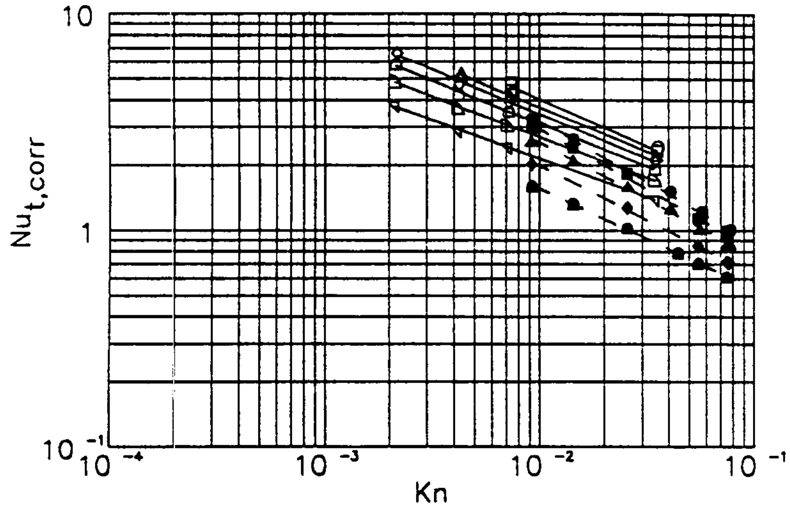

Figure 12.1 Nusselt Number vs. Knudsen Number
To = 80 F, dw = 0.00015 inch, Single wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

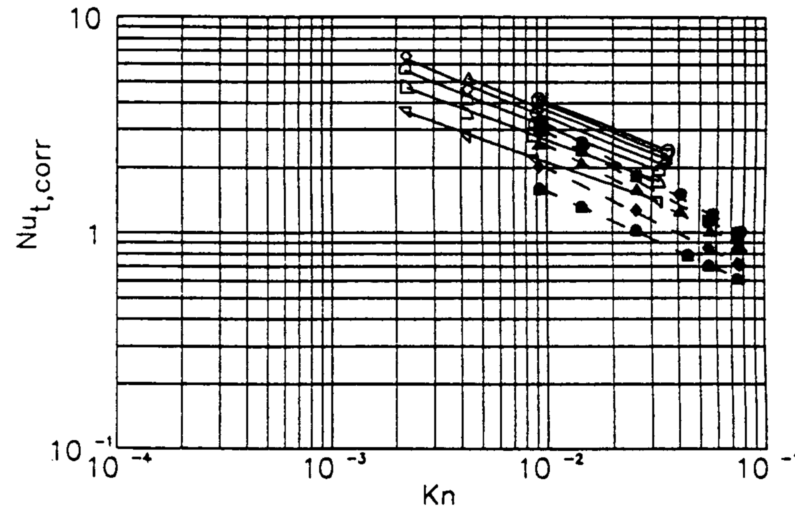

Figure 12.2 Nusselt Number vs. Knudsen Number
To = 100 F, dw = 0.00015 inch, Single wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
D		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

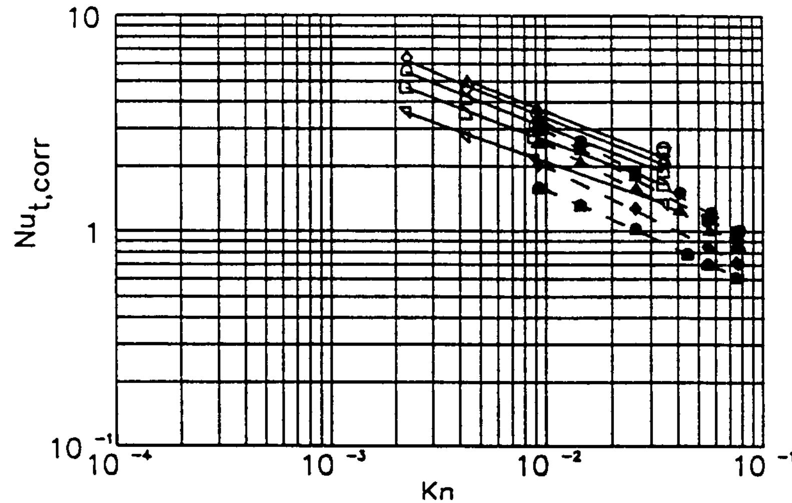

Figure 12.3 Nusselt Number vs. Knudsen Number
To = 120 F, dw = 0.00015 inch, Single wire

Symbols:

Present	Baldwin	Mach No.
◁	●	0.05
▷	◆	0.10
▯		0.15
◇	▲	0.20
△		0.25
□	■	0.30
○		0.35
	●	0.40

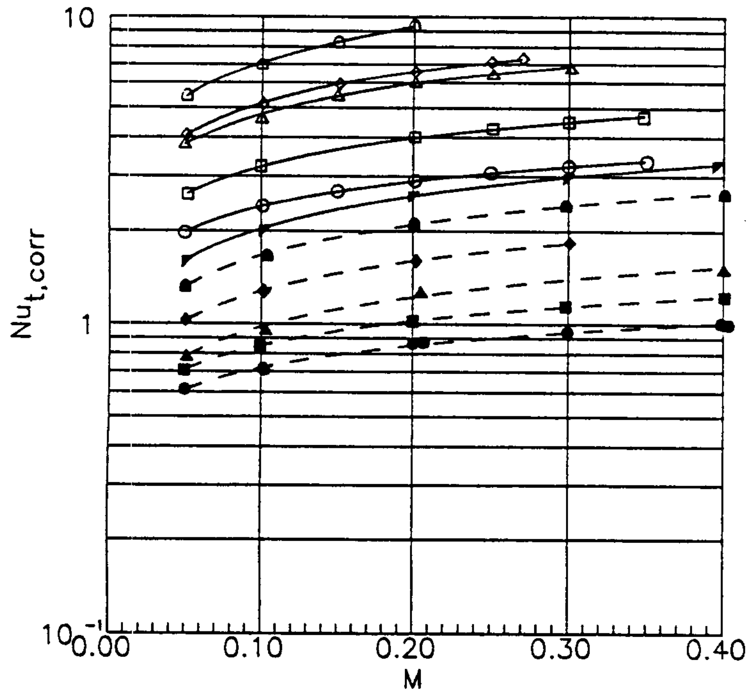

Figure 13.1 Nusselt Number vs. Mach Number
To = 80 F, dw = 0.00015 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

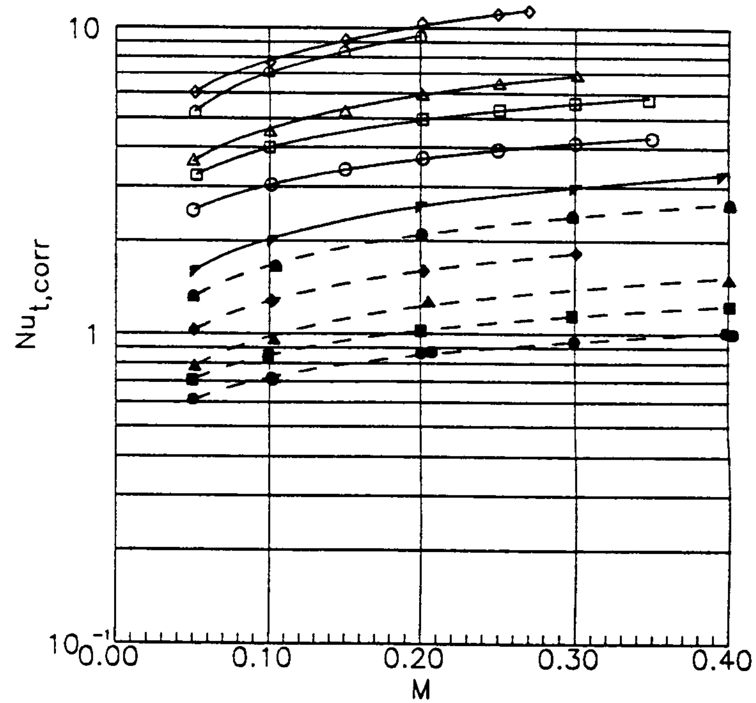

Figure 13.2 Nusselt Number vs. Mach Number
To = 80 F, dw = 0.00032 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

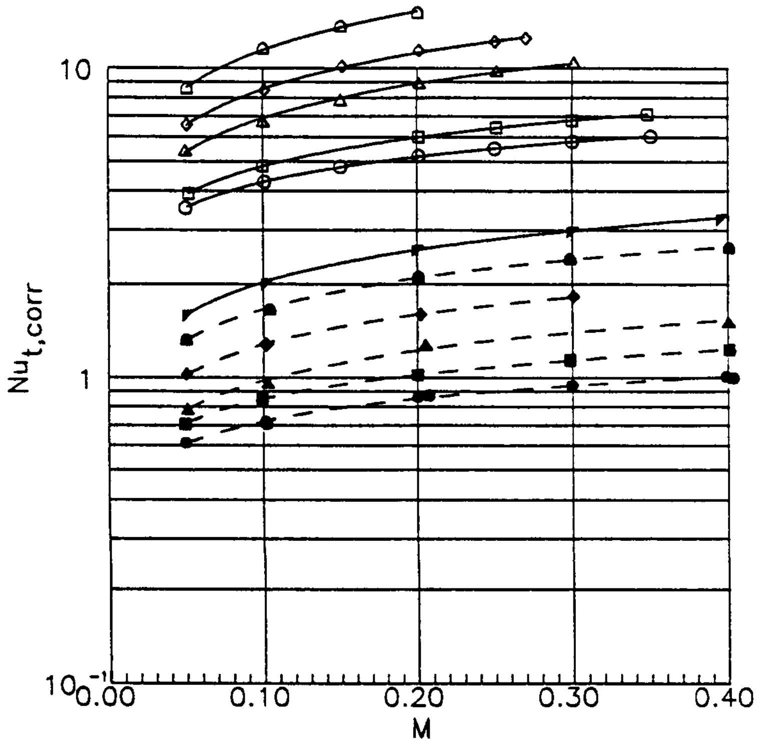

Figure 13.3 Nusselt Number vs. Mach Number
To = 80 F, dw = 0.00050 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

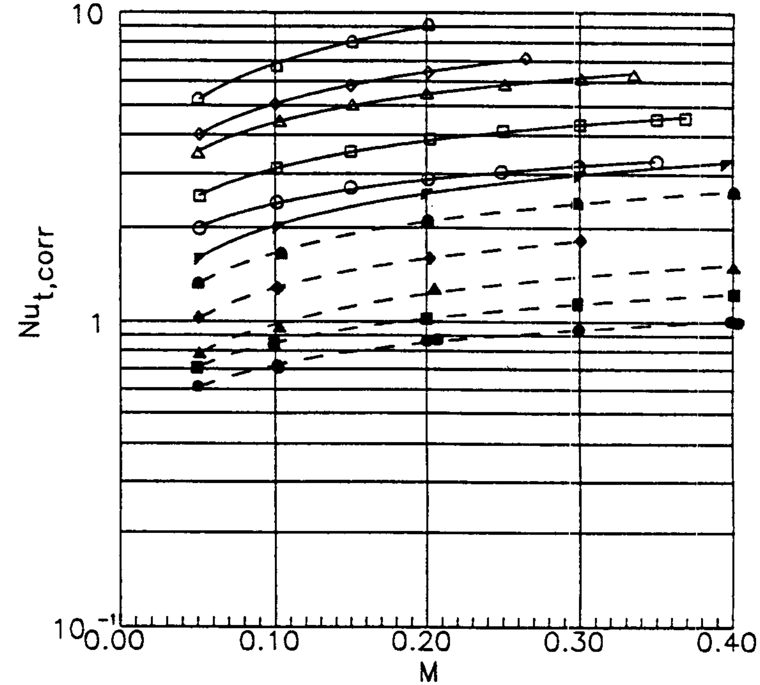

Figure 13.4 Nusselt Number vs. Mach Number
To = 100 F, dw = 0.00015 inch, P -- wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

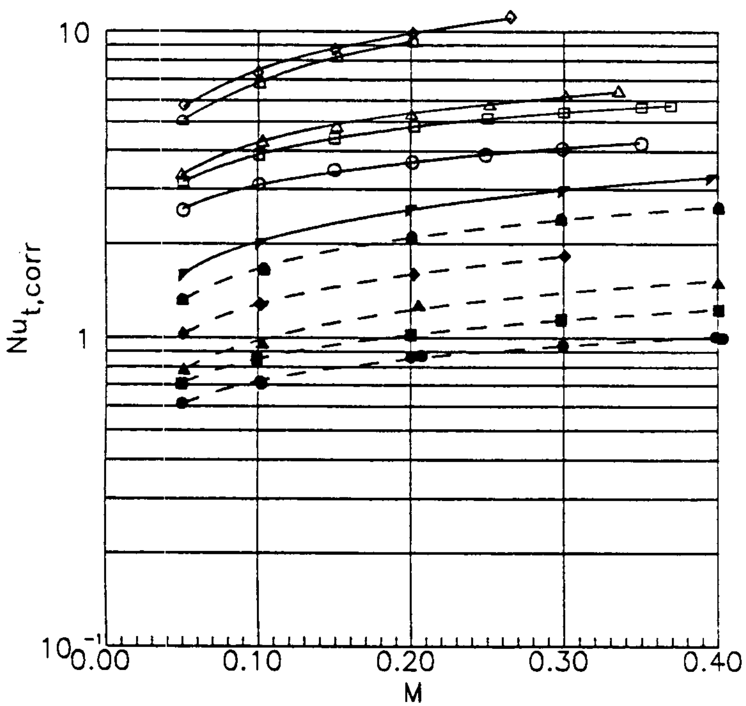

Figure 13.5 Nusselt Number vs. Mach Number
To = 100 F, dw = 0.00032 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	▲	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

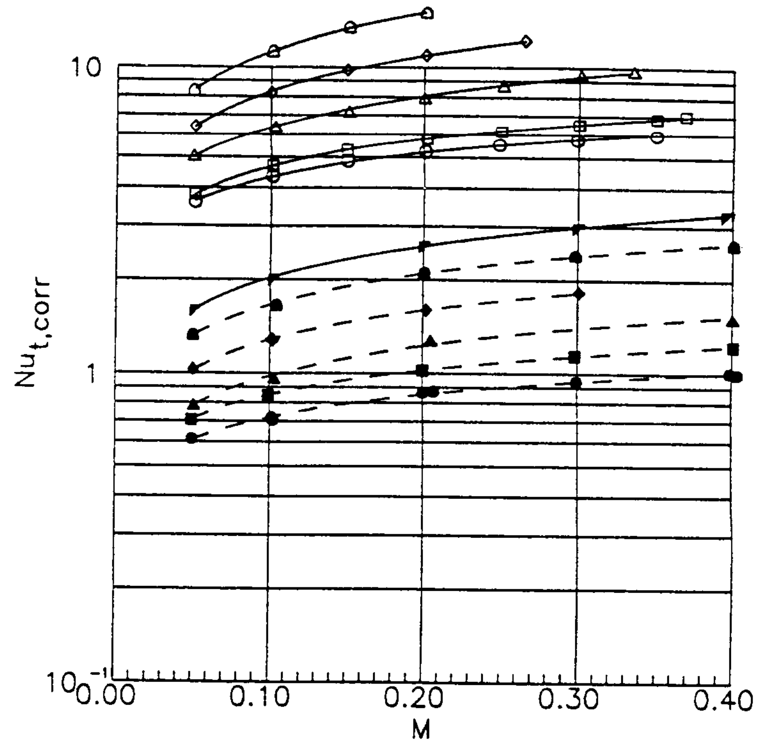

Figure 13.6 Nusselt Number vs. Mach Number
To = 100 F, dw = 0.00050 inch, P – wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	▲	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

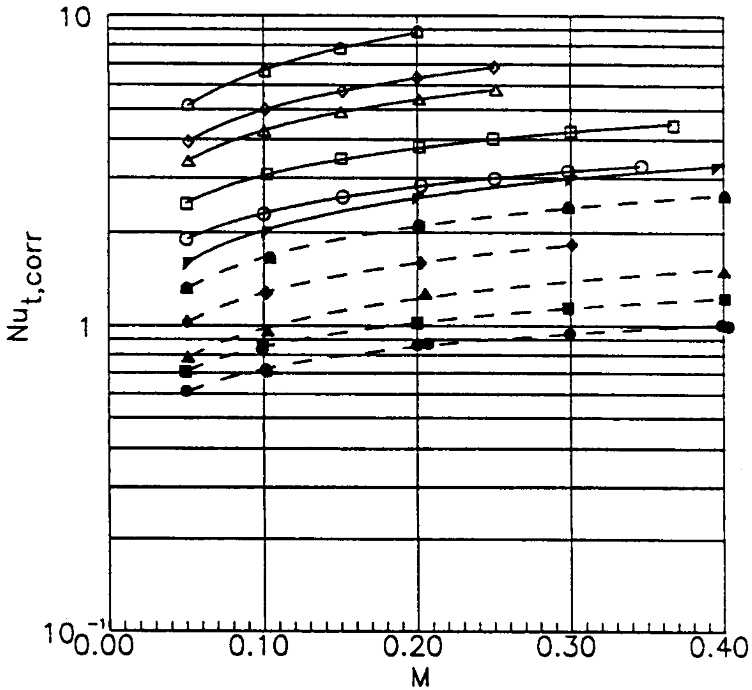

Figure 13.7 Nusselt Number vs. Mach Number
To = 120 F, dw = 0.00015 inch, P–wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
Ω	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

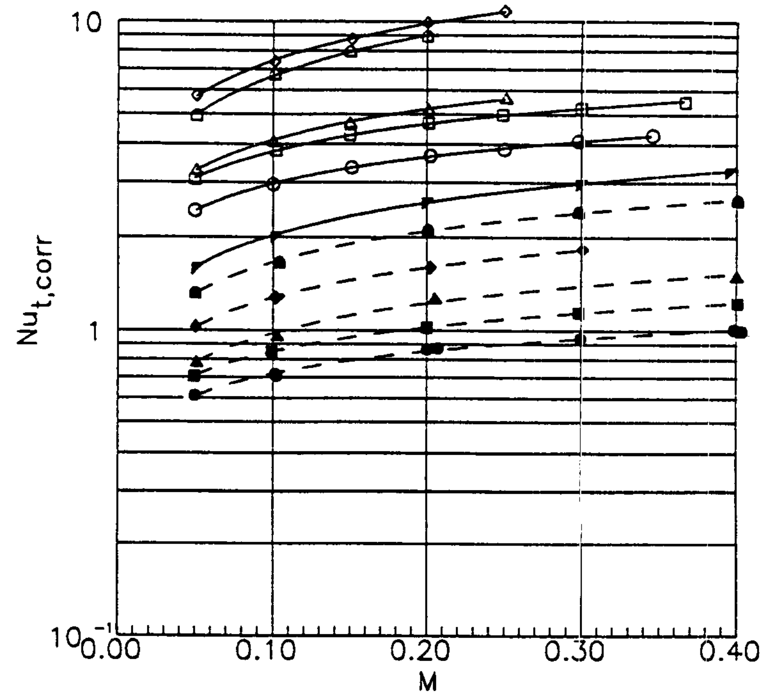

Figure 13.8 Nusselt Number vs. Mach Number
To = 120 F, dw = 0.00032 inch, P–wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
Ω	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

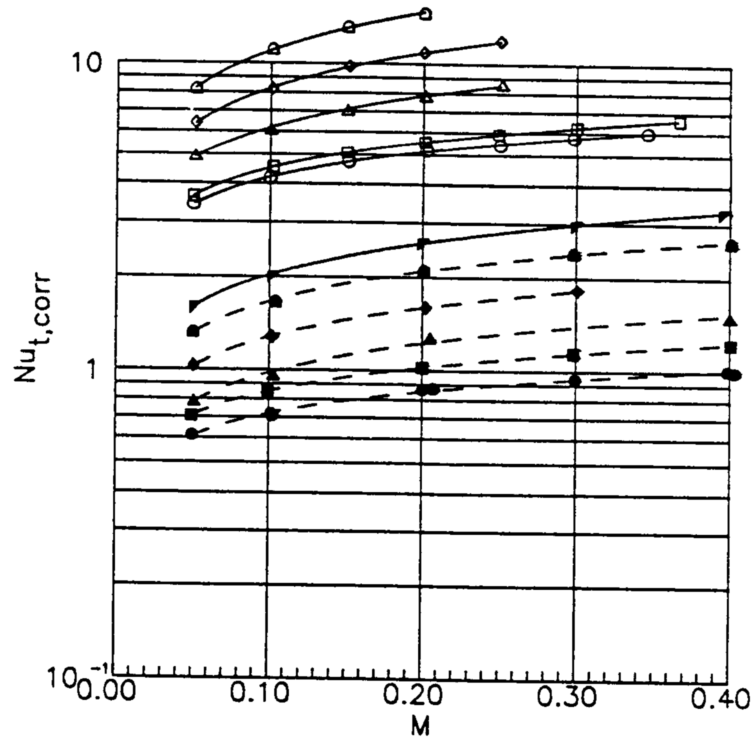

Figure 13.9 Nusselt Number vs. Mach Number
To = 120 F, dw = 0.00050 inch, P-wire
(Data corrected due to Impedance)

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	⬟	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

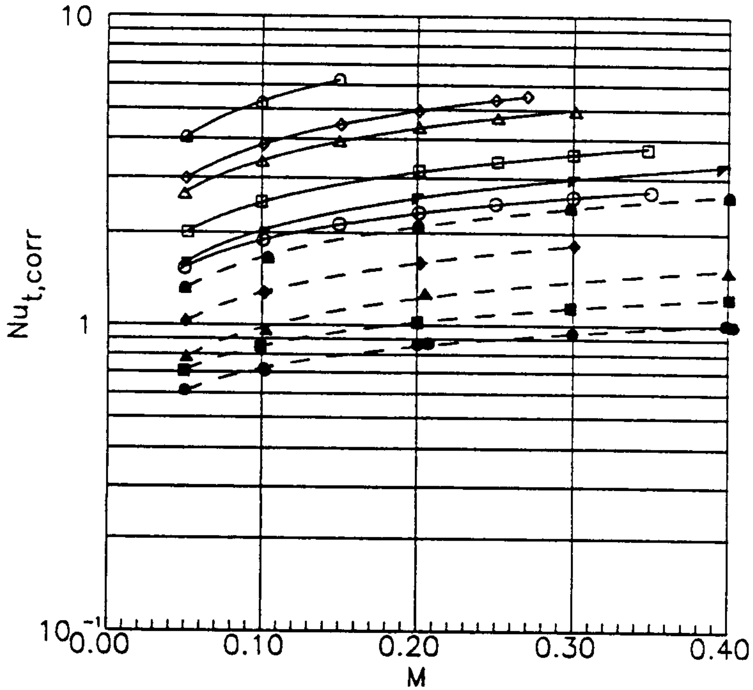

Figure 14.1 Nusselt Number vs. Mach Number
To = 80 F, dw = 0.00015 inch, Y – wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

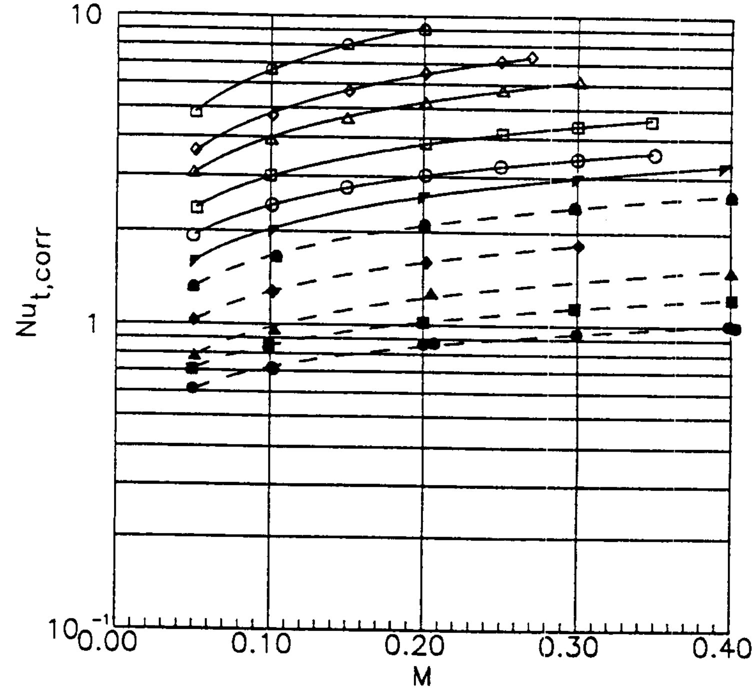

Figure 14.2 Nusselt Number vs. Mach Number
To = 80 F, dw = 0.00032 inch, Y – wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

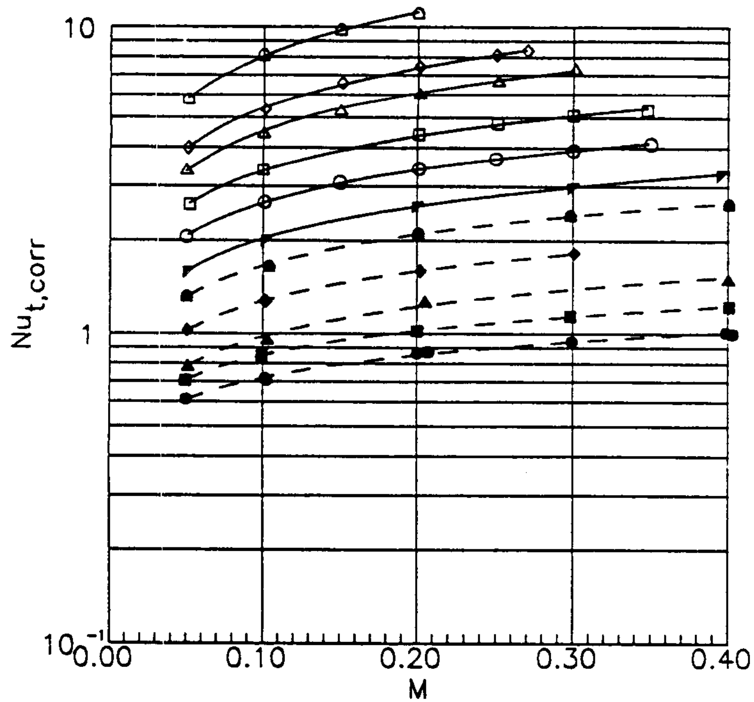

Figure 14.3 Nusselt Number vs. Mach Number
To = 80 F, dw = 0.00050 inch, Y – wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

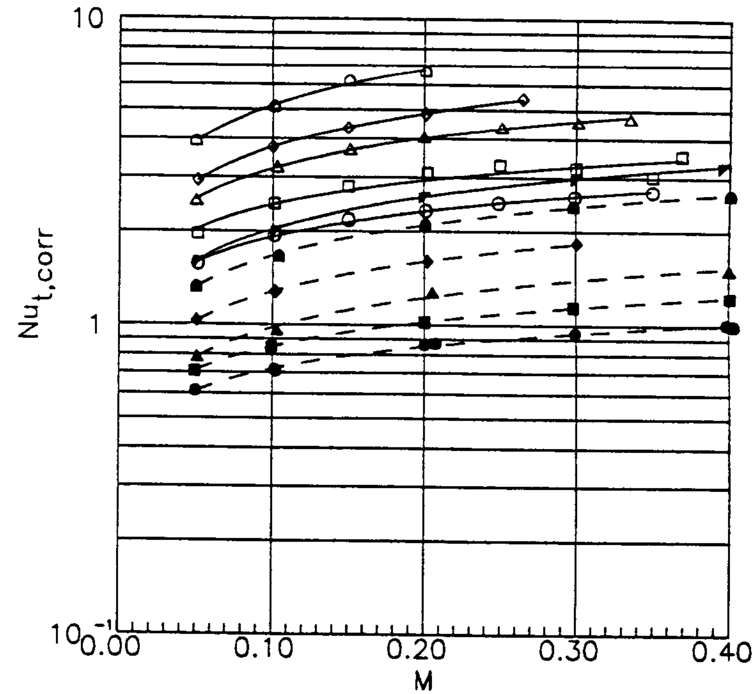

Figure 14.4 Nusselt Number vs. Mach Number
To = 100 F, dw = 0.00015 inch, Y – wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

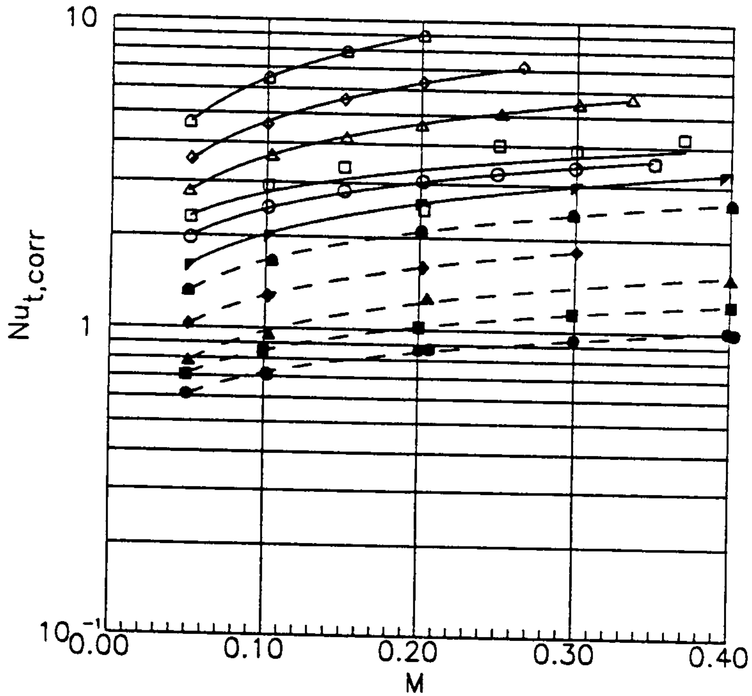

Figure 14.5 Nusselt Number vs. Mach Number
To = 100 F, dw = 0.00032 inch, Y – wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

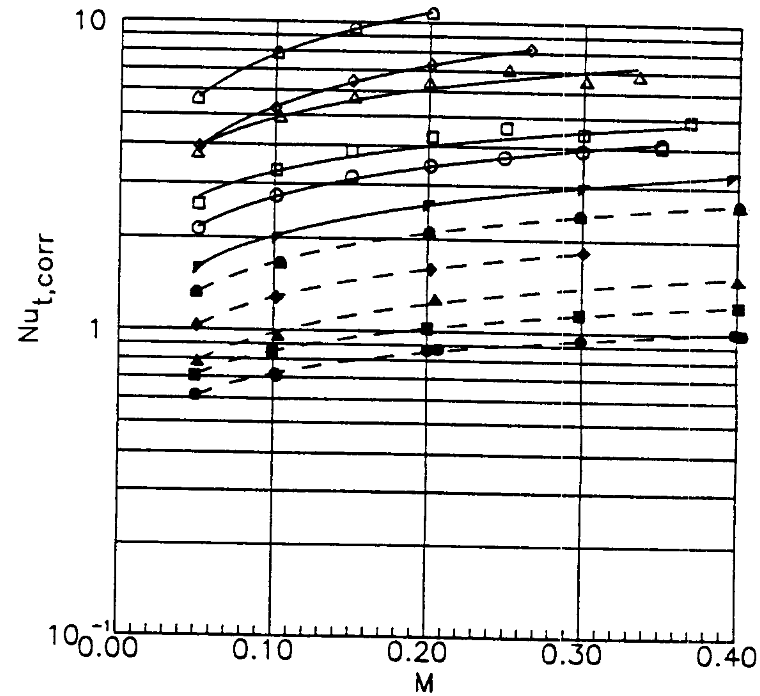

Figure 14.6 Nusselt Number vs. Mach Number
To = 100 F, dw = 0.00050 inch, Y – wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

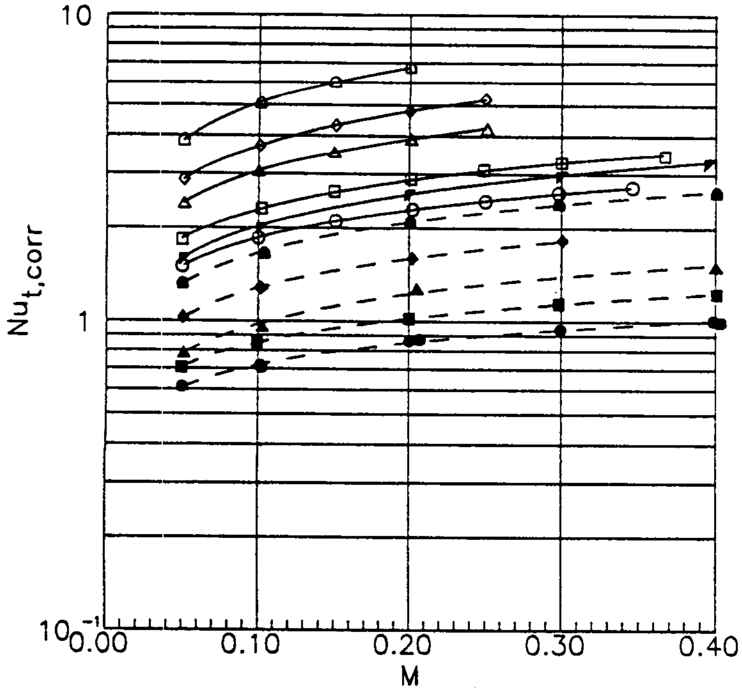

Figure 14.7 Nusselt Number vs. Mach Number
To = 120 F, dw = 0.00015 inch, Y-wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	◓	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

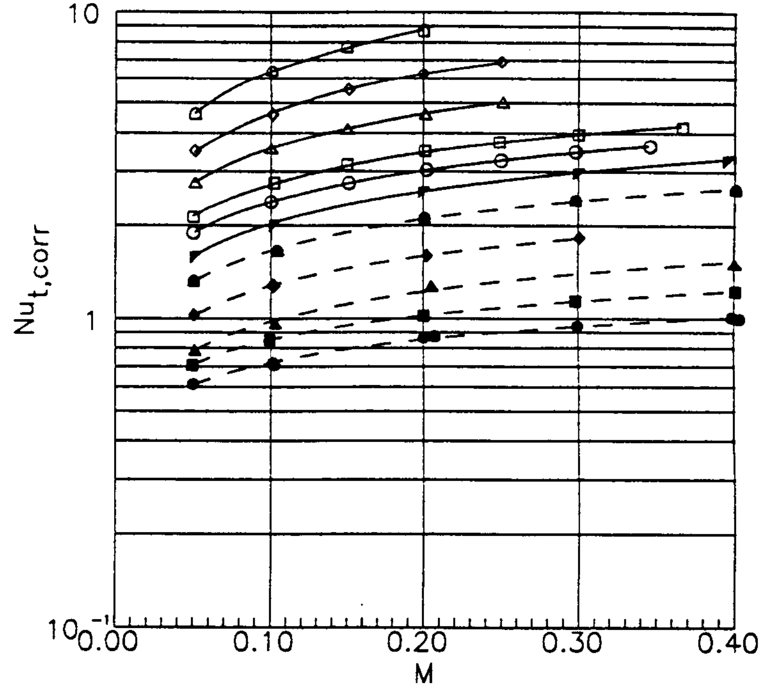

Figure 14.8 Nusselt Number vs. Mach Number
To = 120 F, dw = 0.00032 inch, Y-wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	◓	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

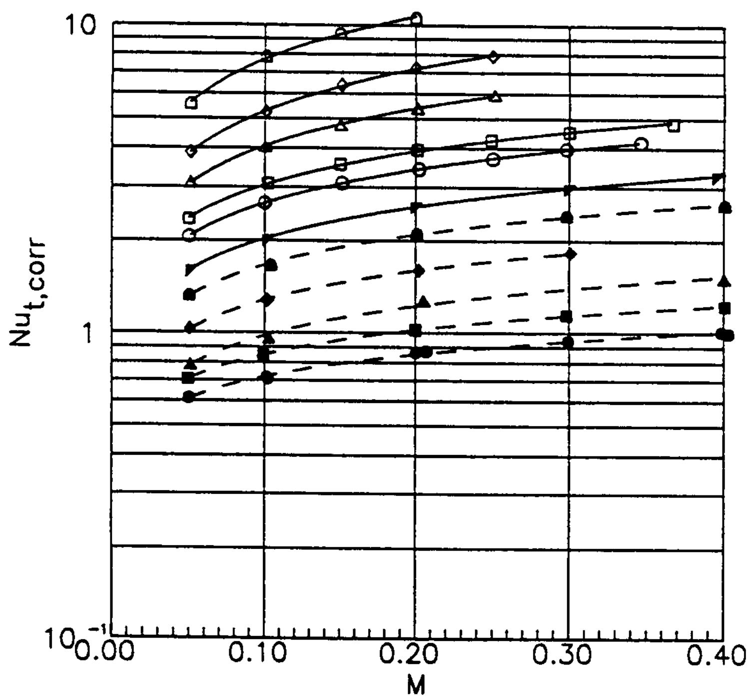

Figure 14.9 Nusselt Number vs. Mach Number
To = 120 F, dw = 0.00050 inch, Y-wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

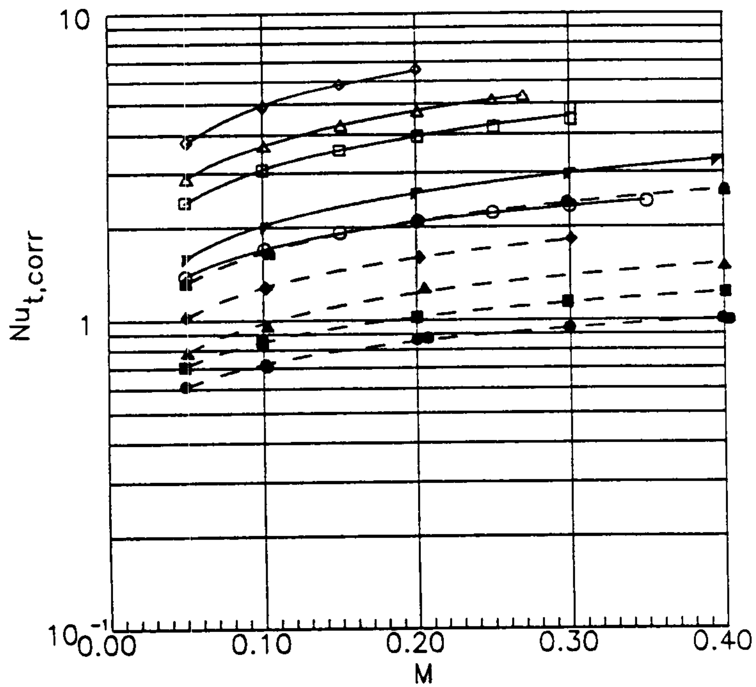

Figure 15.1 Nusselt Number vs. Mach Number
To = 80 F, dw = 0.00015 inch, Single wire

Symbols: Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	◓	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

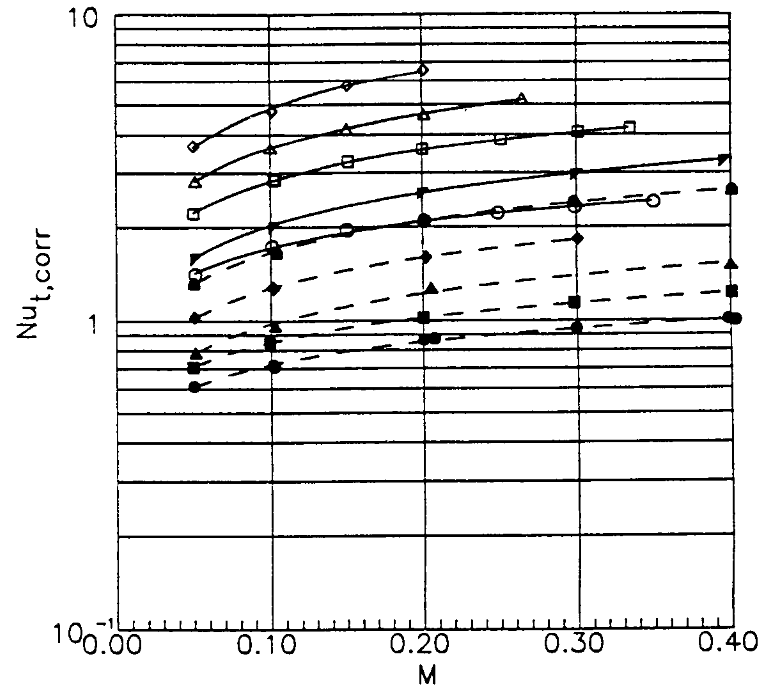

Figure 15.2 Nusselt Number vs. Mach Number
To = 100 F, dw = 0.00015 inch, Single wire

Symbols: Present	Knudsen No.	Baldwin	Knudsen No.
⌂	0.0022	◤	0.009
◇	0.0043	◓	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

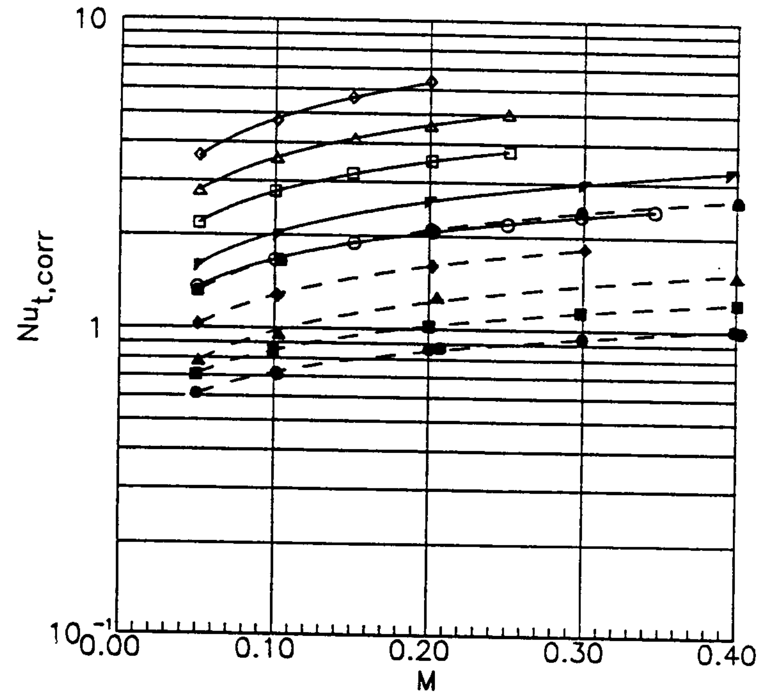

Figure 15.3 Nusselt Number vs. Mach Number
To = 120 F, dw = 0.00015 inch, Single wire

Symbols:

Present	Knudsen No.	Baldwin	Knudsen No.
▢	0.0022	◤	0.009
◇	0.0043	☗	0.014
△	0.0090	◆	0.025
□	0.0180	▲	0.040
○	0.0340	■	0.055
		●	0.075

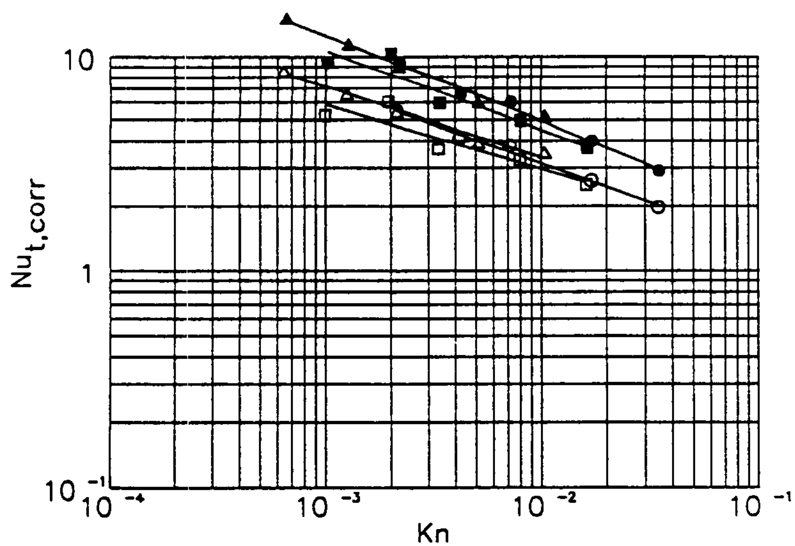

Figure 16.1 Nusselt Number vs. Knudsen Number
To = 80 F, P–wire
(Data corrected due to Impedance)

Symbols:

Mach Number 0.20	Mach Number 0.15	dw, inch
○	●	0.0015
□	■	0.0032
△	▲	0.0050

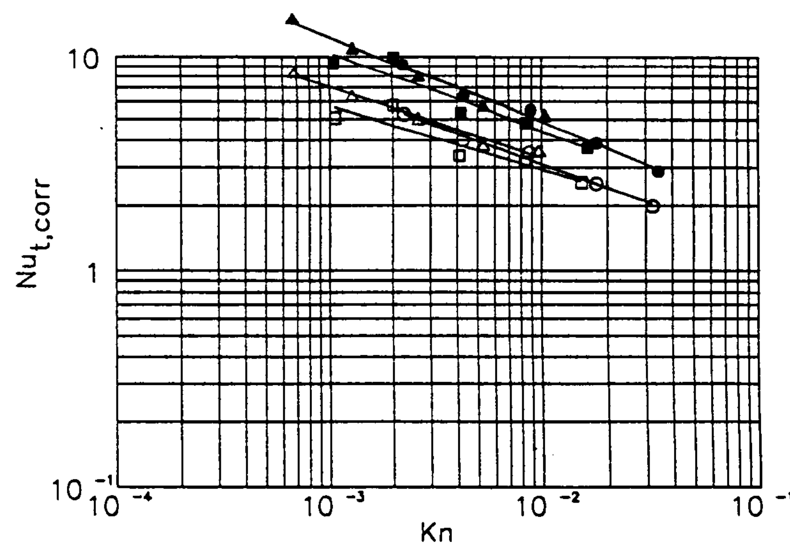

Figure 16.2 Nusselt Number vs. Knudsen Number
To = 100 F, P–wire
(Data corrected due to Impedance)

Symbols:

Mach Number 0.20	Mach Number 0.15	dw, inch
○	●	0.0015
□	■	0.0032
△	▲	0.0050

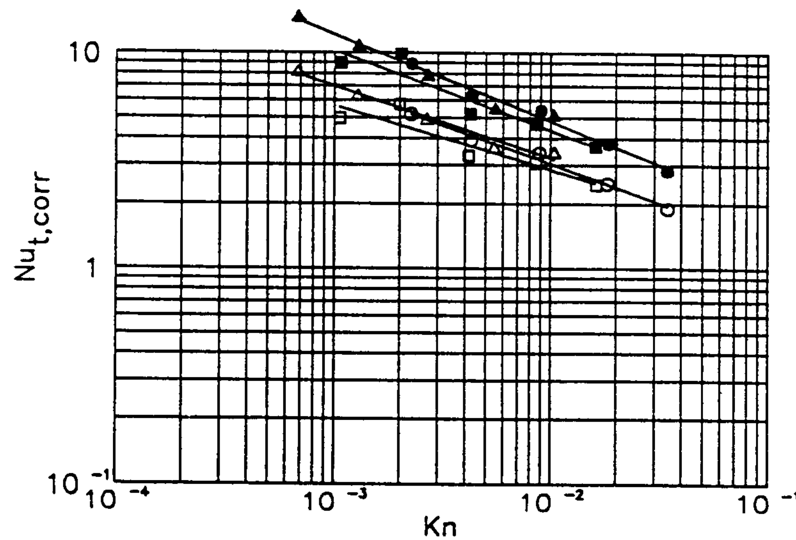

Figure 16.3 Nusselt Number vs. Knudsen Number
To = 120 F, P–wire
(Data corrected due to Impedance)

Symbols:

Mach Number 0.20	Mach Number 0.15	dw, inch
○	●	0.0015
□	■	0.0032
△	▲	0.0050

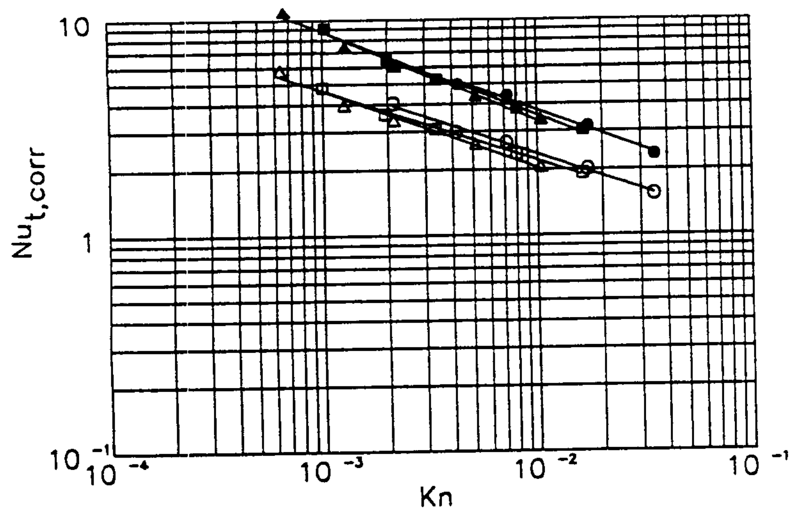

Figure 17.1 Nusselt Number vs. Knudsen Number
To = 80 F, Y – wire

Symbols:

Mach Number 0.20	0.15	dw, inch
○	●	0.0015
□	■	0.0032
△	▲	0.0050

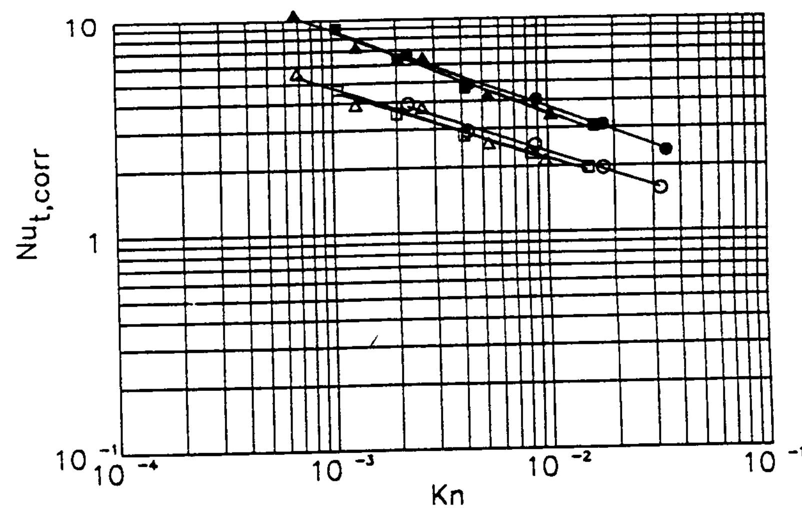

Figure 17.2 Nusselt Number vs. Knudsen Number
To = 100 F, Y – wire

Symbols:

Mach Number 0.20	0.15	dw, inch
○	●	0.0015
□	■	0.0032
△	▲	0.0050

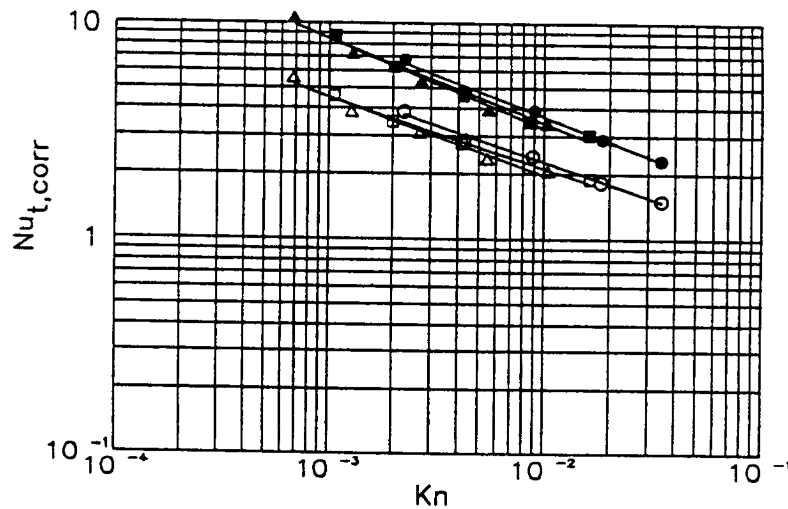

Figure 17.3 Nusselt Number vs. Knudsen Number
To = 120 F, Y – wire

Symbols:

Mach Number 0.20	0.15	dw, inch
○	●	0.0015
□	■	0.0032
△	▲	0.0050

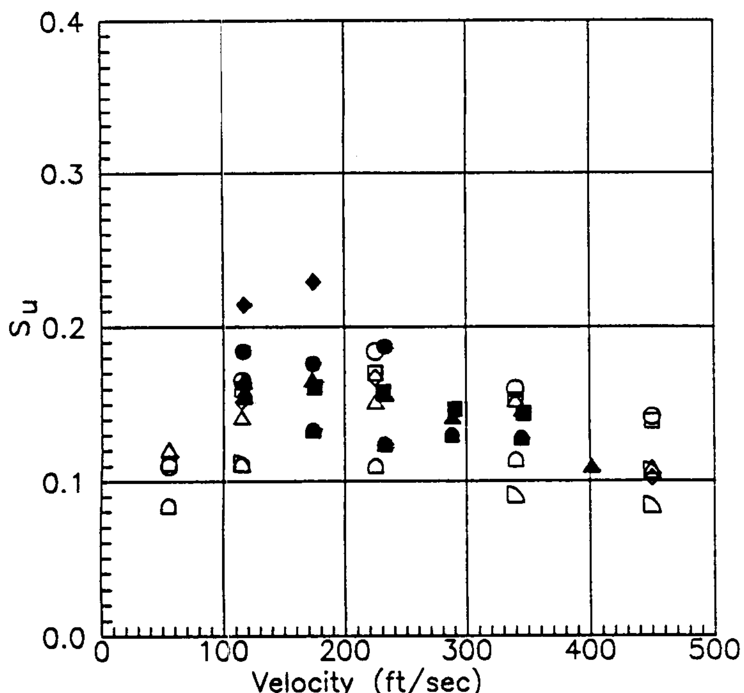

Figure 18.1 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00015 inch, P-wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
☗	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

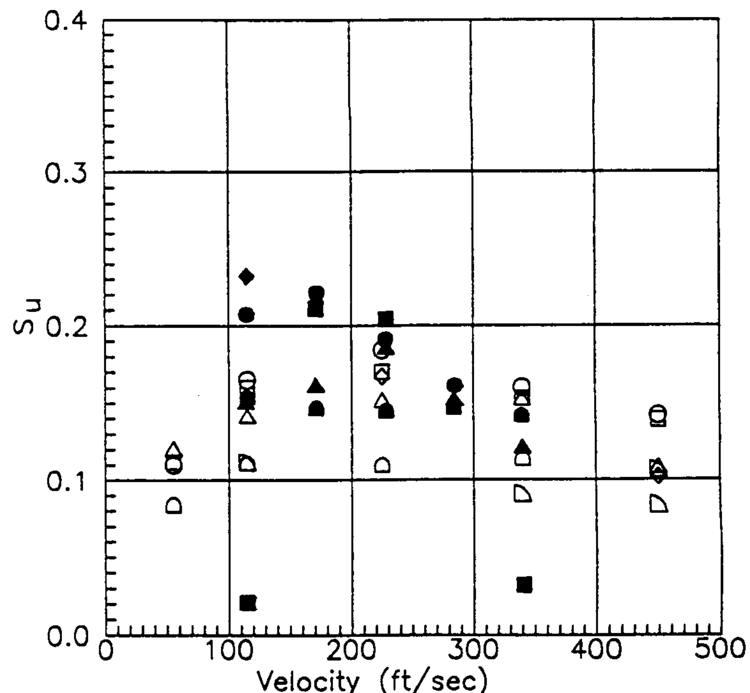

Figure 18.2 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00032 inch, P-wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
☗	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

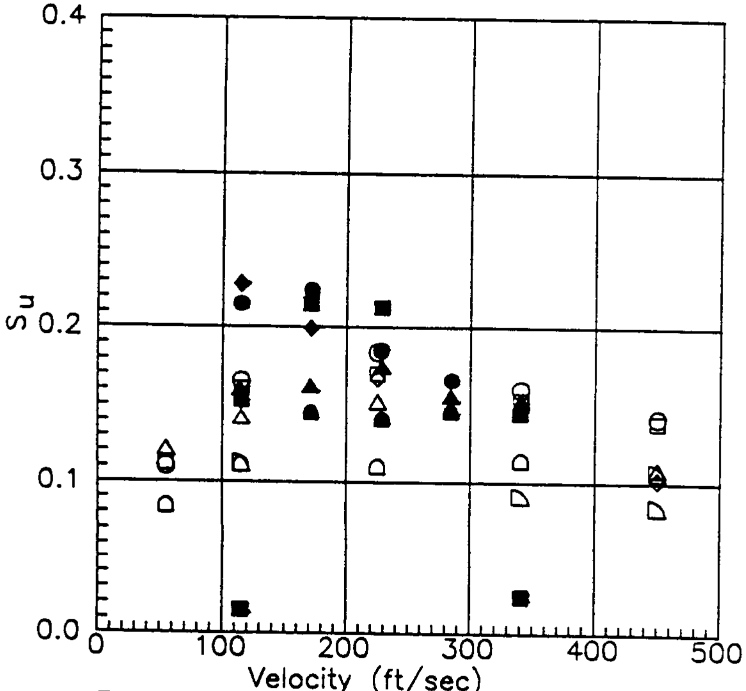

Figure 18.3 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00050 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

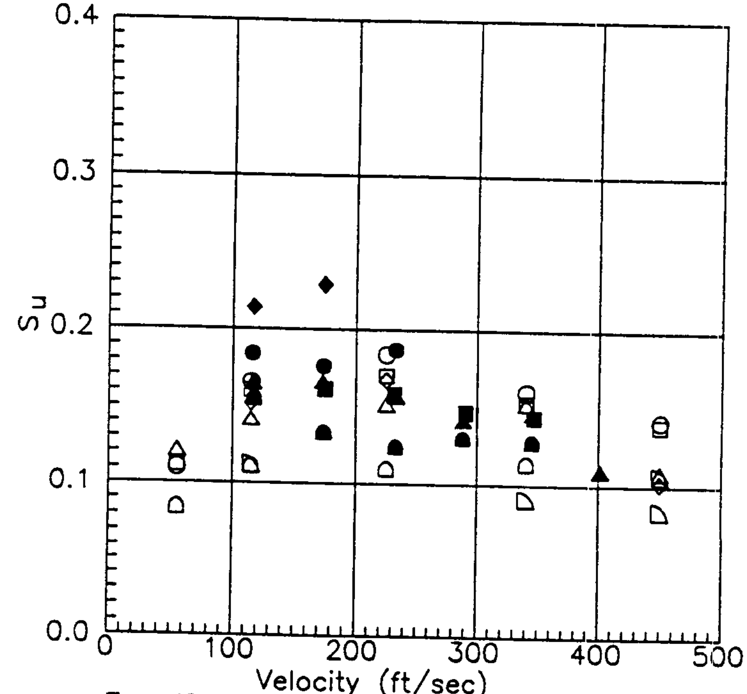

Figure 18.4 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00015 inch, P–wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

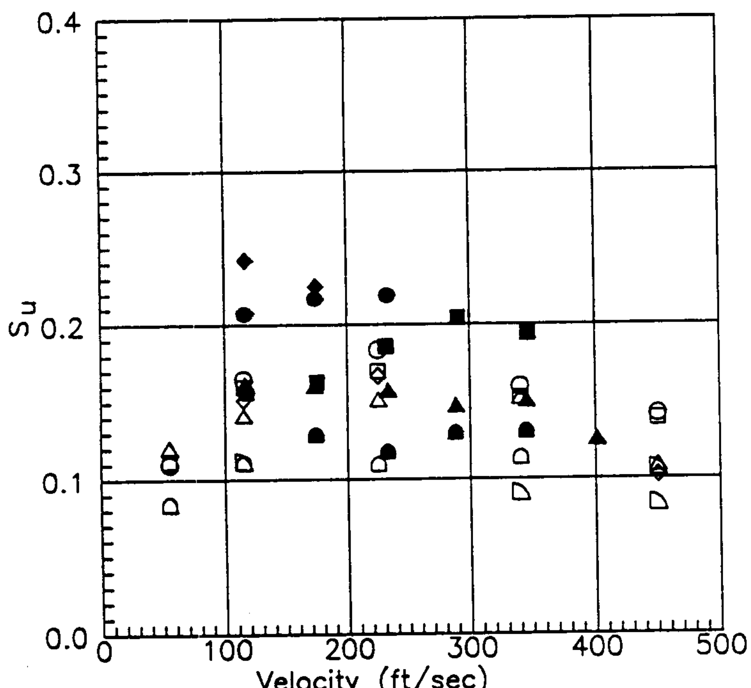

Figure 18.5 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00032 inch, P–wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌓	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

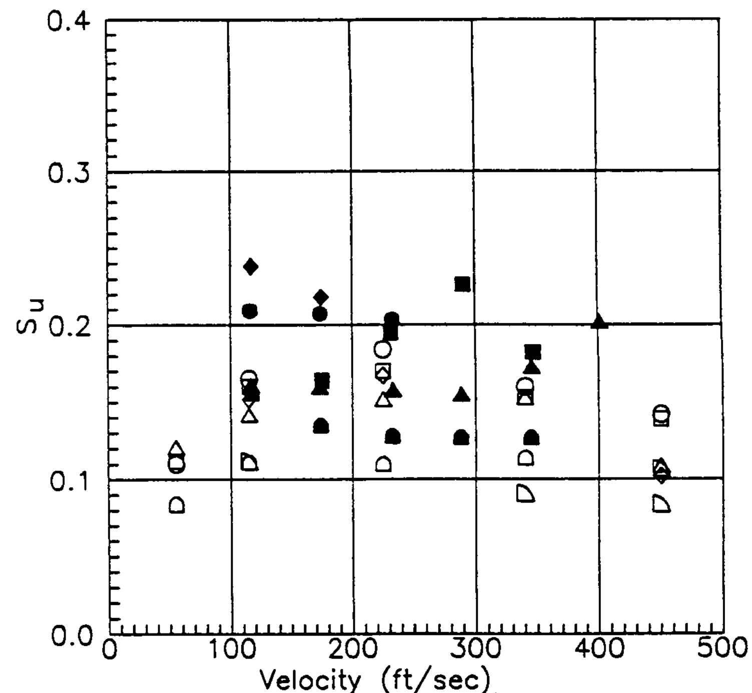

Figure 18.6 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00050 inch, P–wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌓	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

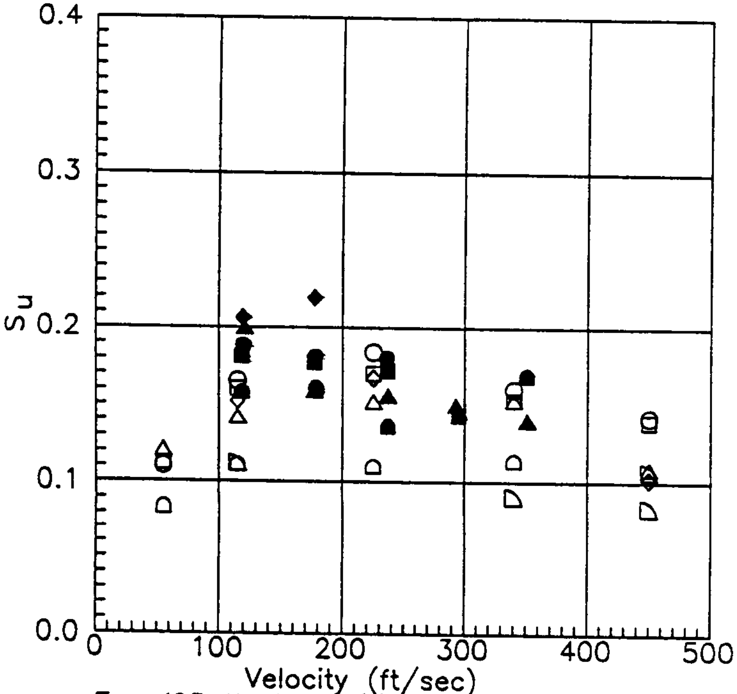

Figure 18.7 Velocity vs. S(U), E = f(Uρ,To), local fit
dw = 0.00015 inch, P-wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
⬟	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

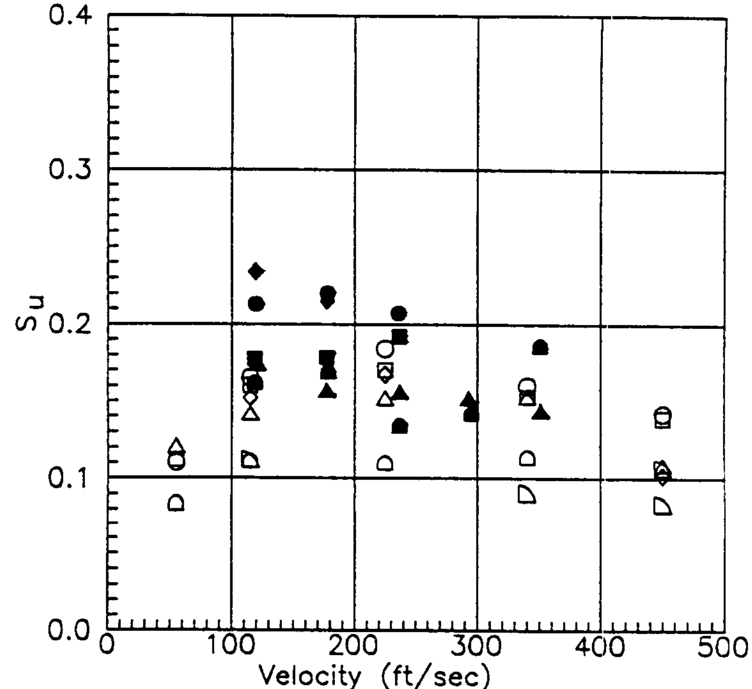

Figure 18.8 Velocity vs. S(U), E = f(Uρ,To), local fit
dw = 0.00032 inch, P-wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
⬟	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

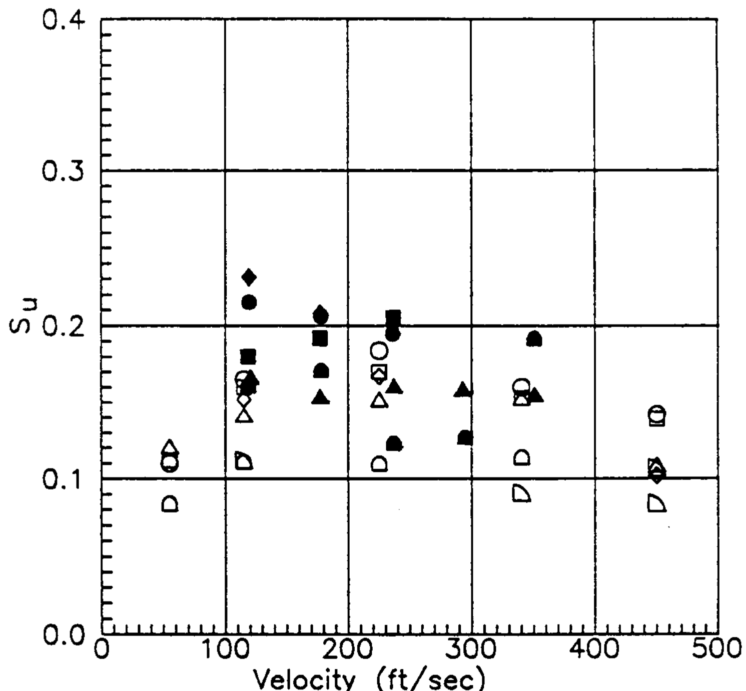

Figure 18.9 Velocity vs. S(U), E = f(U,ρ,To), local fit
dw = 0.00050 inch, P-wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

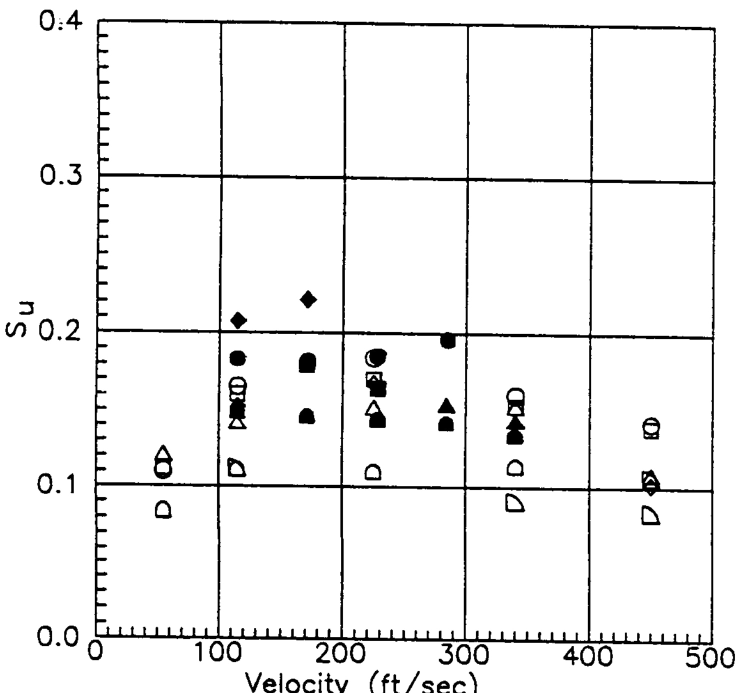

Figure 19.1 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, P-wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

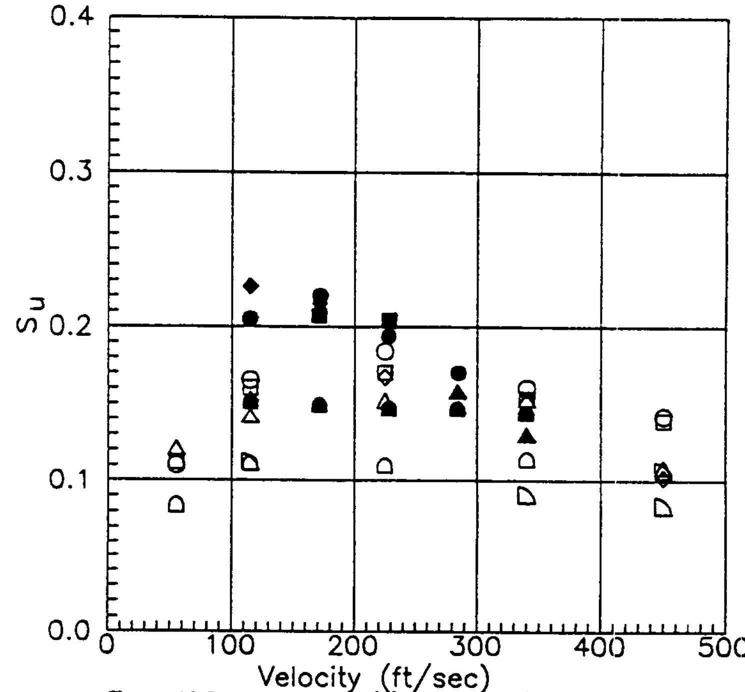

Figure 19.2 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, P-wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

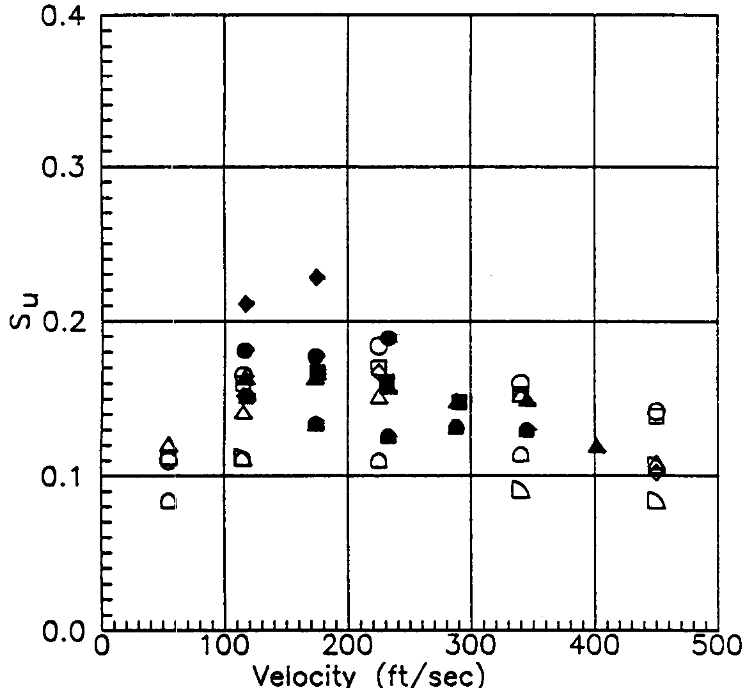

Figure 19.4 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, P-wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

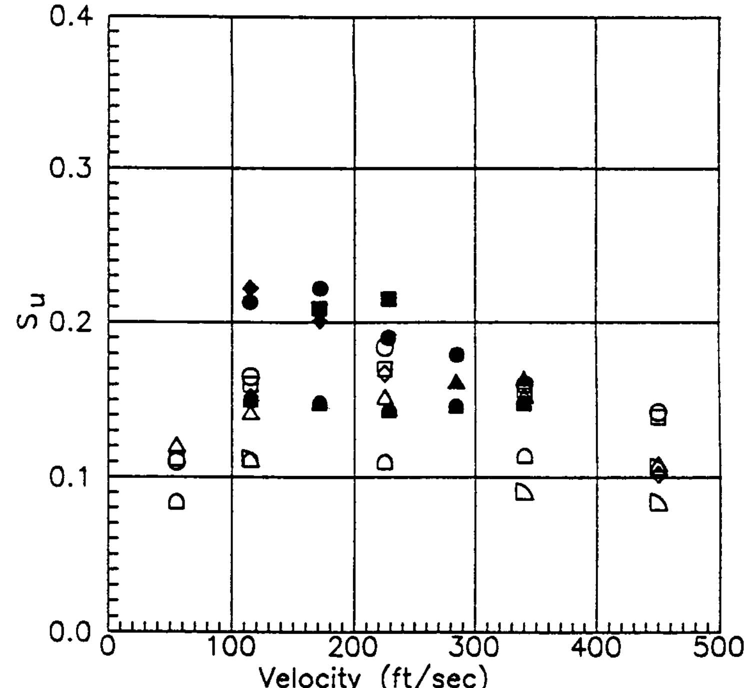

Figure 19.3 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, P-wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

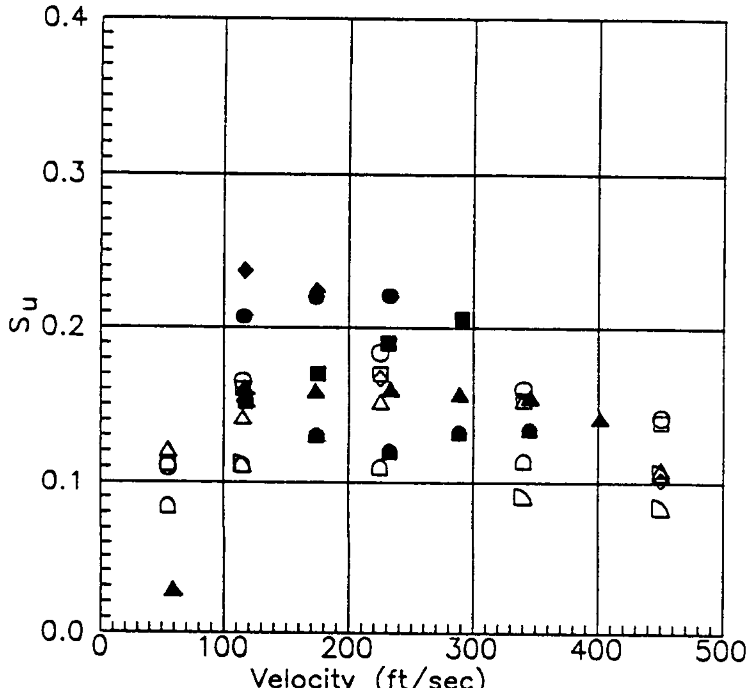

Figure 19.5 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, P–wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

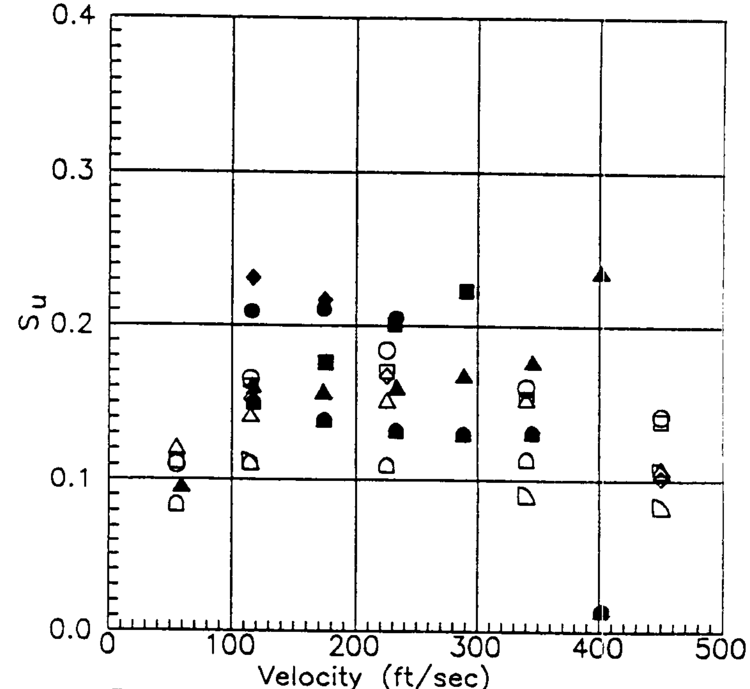

Figure 19.6 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, P–wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

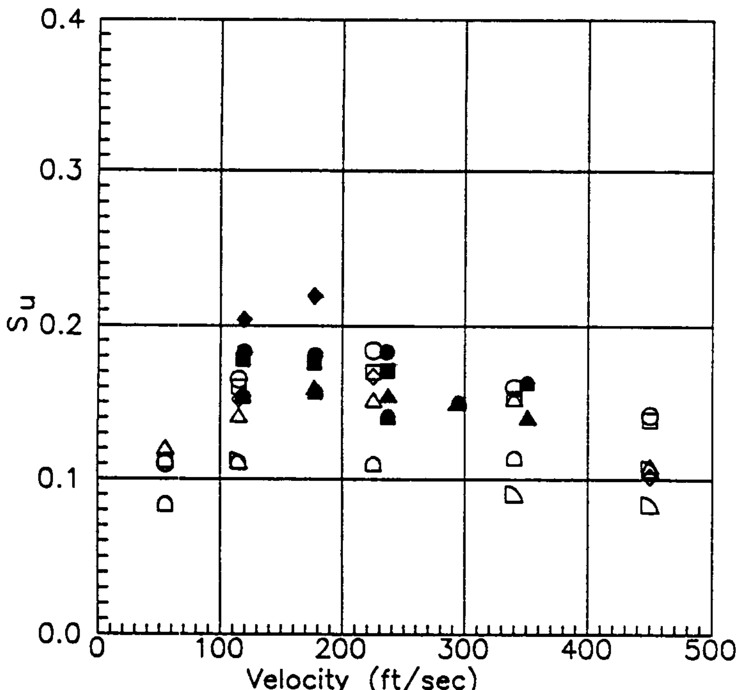

Figure 19.7 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, P-wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

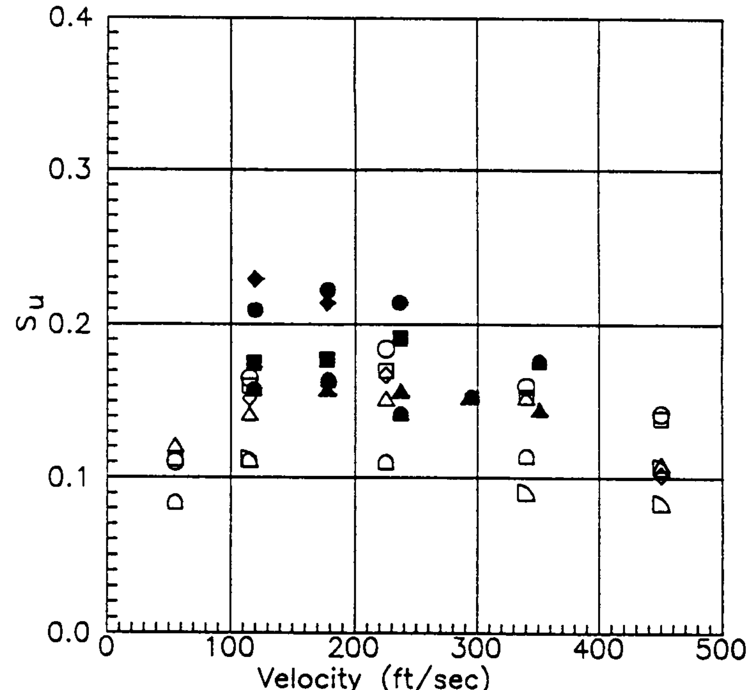

Figure 19.8 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, P-wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

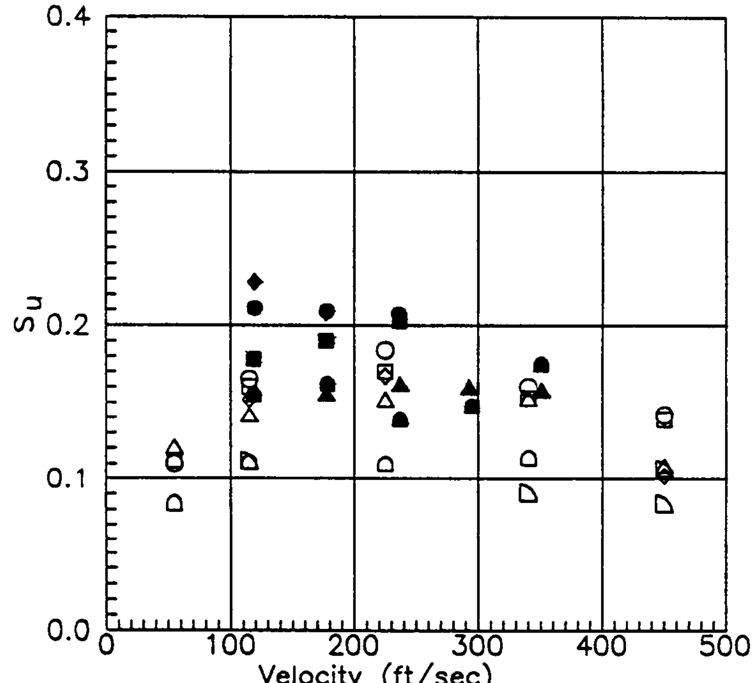

Figure 19.9 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, P–wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
◗	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌓	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

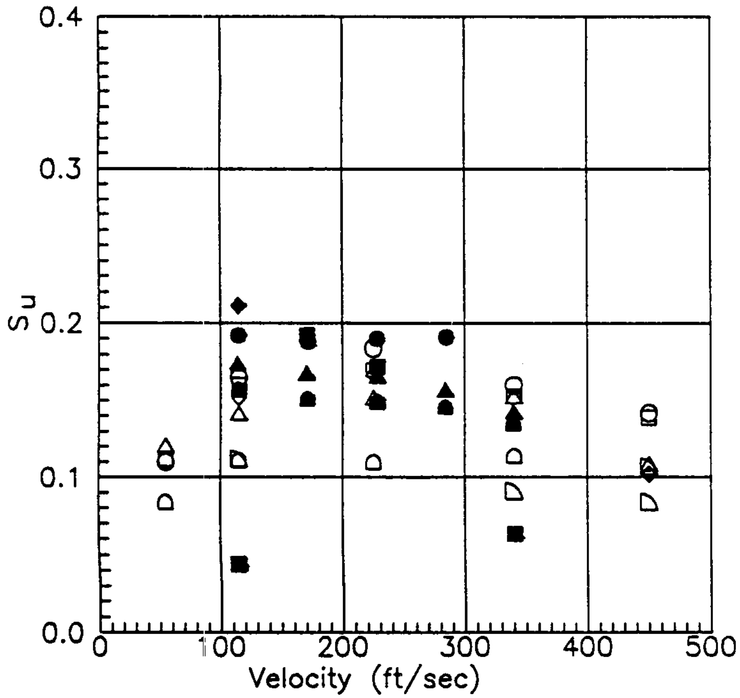

Figure 20.1 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00015 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

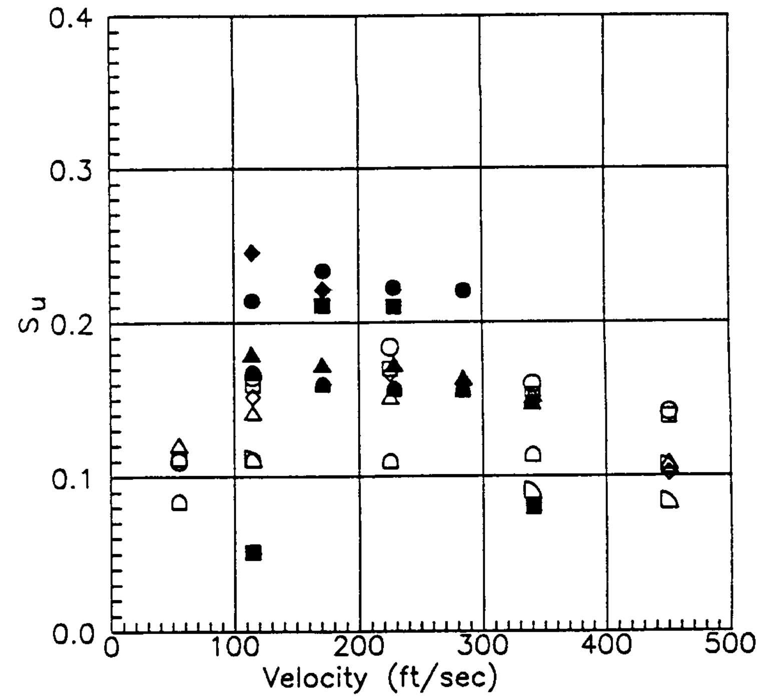

Figure 20.2 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00032 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

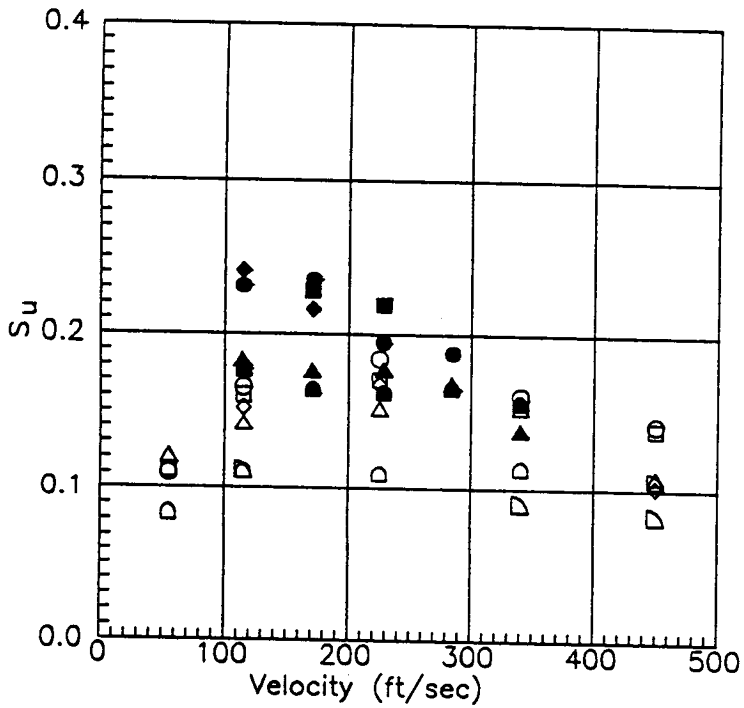

Figure 20.3 Velocity vs. S(U), E = f(U,ρ,To), local fit
dw = 0.00050 inch, Y-wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

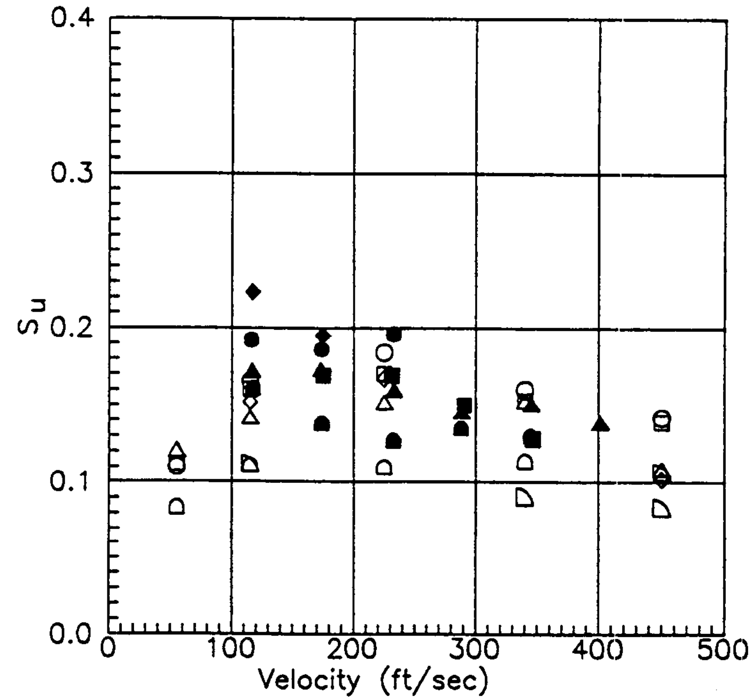

Figure 20.4 Velocity vs. S(U), E = f(U,ρ,To), local fit
dw = 0.00015 inch, Y-wire, To = 100

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

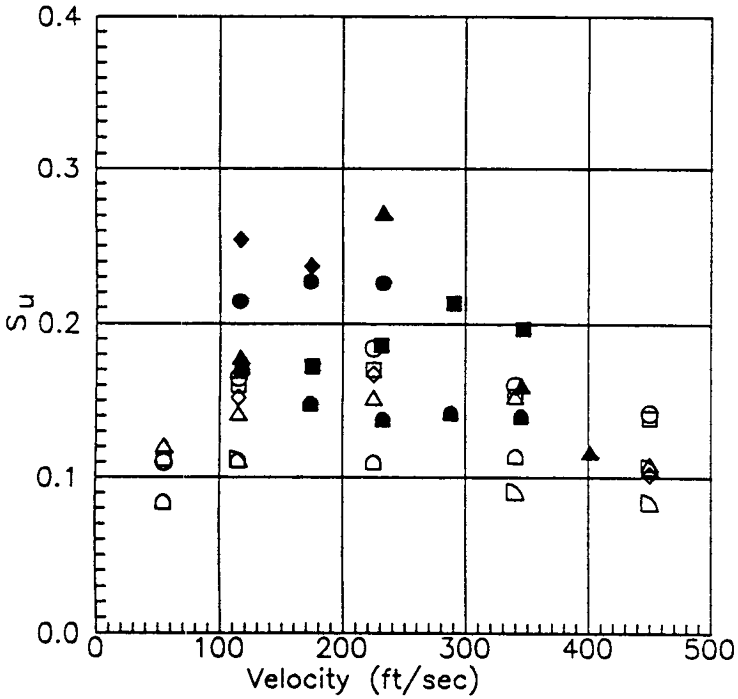

Figure 20.5 Velocity vs. S(U), E = f(U,ρ,To), local fit
dw = 0.00032 inch, Y-wire, To = 100

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
☗	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

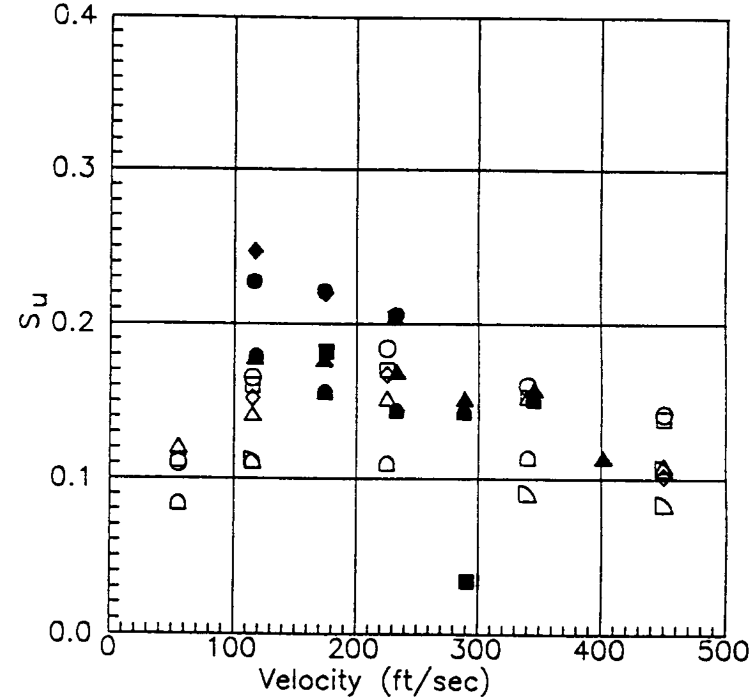

Figure 20.6 Velocity vs. S(U), E = f(U,ρ,To), local fit
dw = 0.00050 inch, Y-wire, To = 100

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
☗	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

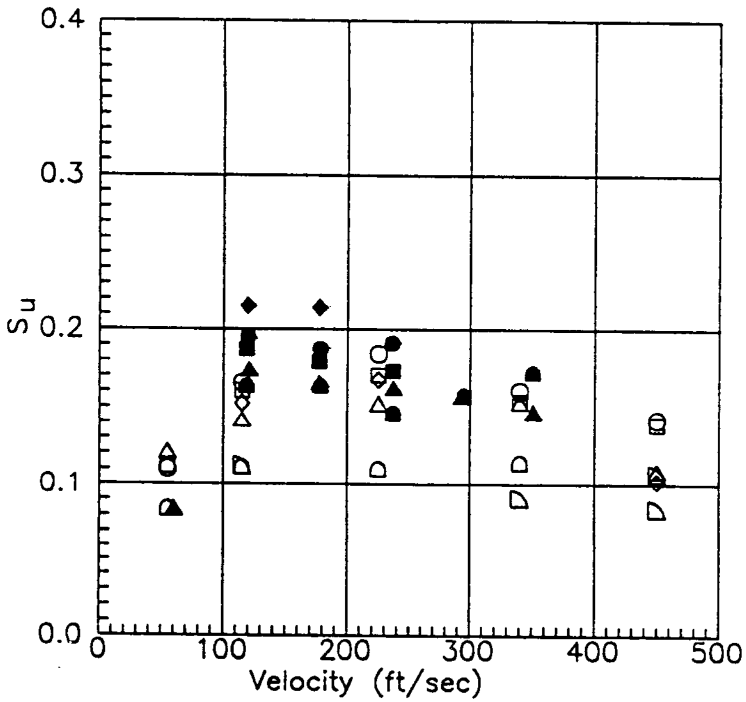

Figure 20.7 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00015 inch, Y-wire, To = 120

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

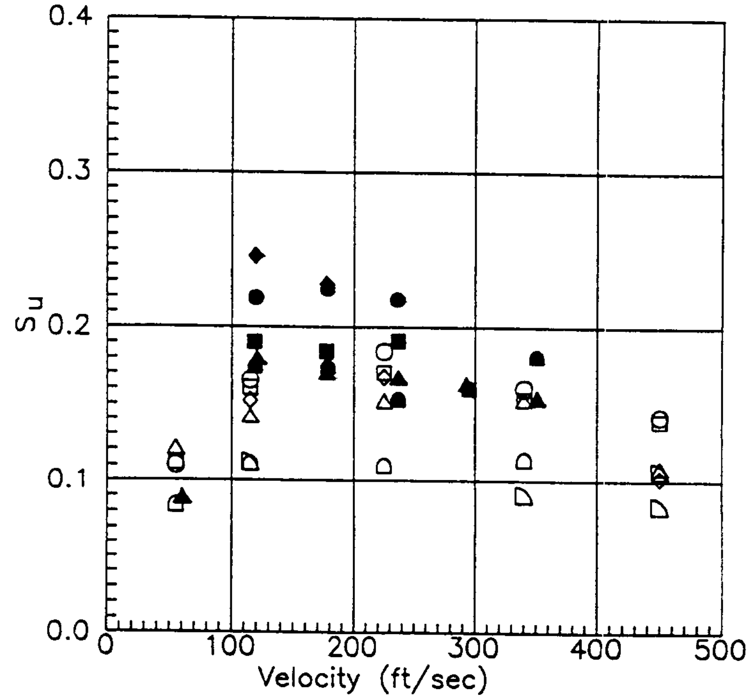

Figure 20.8 Velocity vs. S(U), E = f(U, ρ, To), local fit
dw = 0.00032 inch, Y-wire, To = 120

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

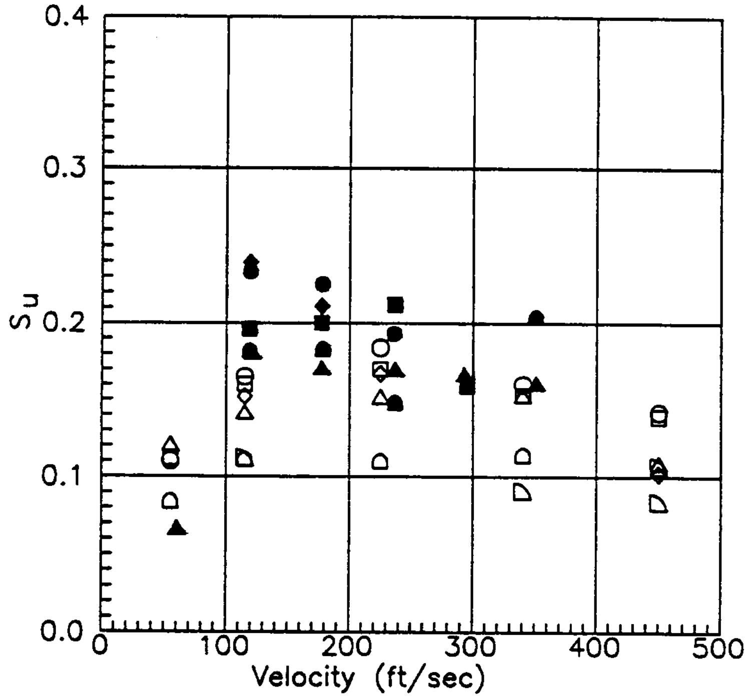

Figure 20.9 Velocity vs. S(U), E = f(U, ρ, Tc), local fit
dw = 0.00050 inch, Y-wire, To = 120

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

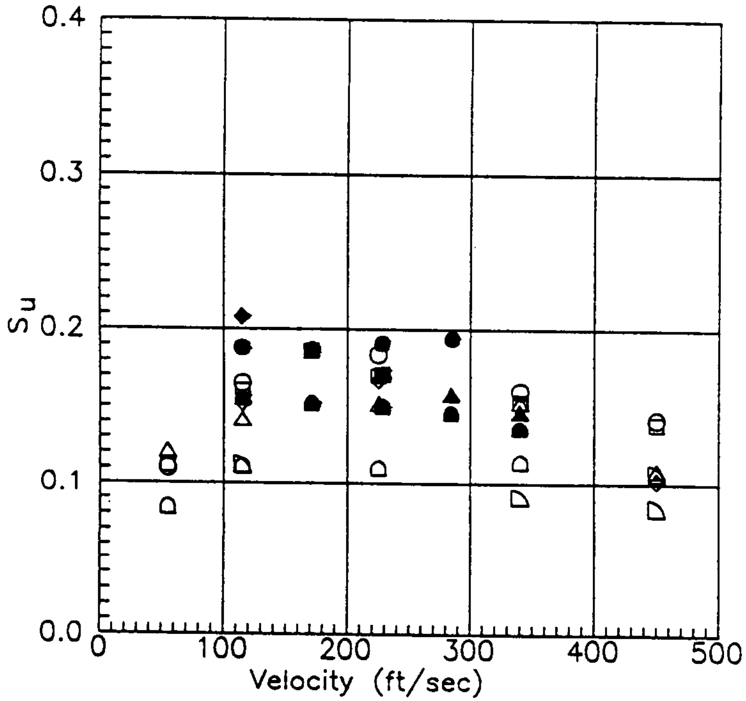

Figure 21.1 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, Y-wire, To = 80 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
◗	0.037	ꓷ	0.012
▲	0.074	◇	0.015
■	0.142	Ɑ	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

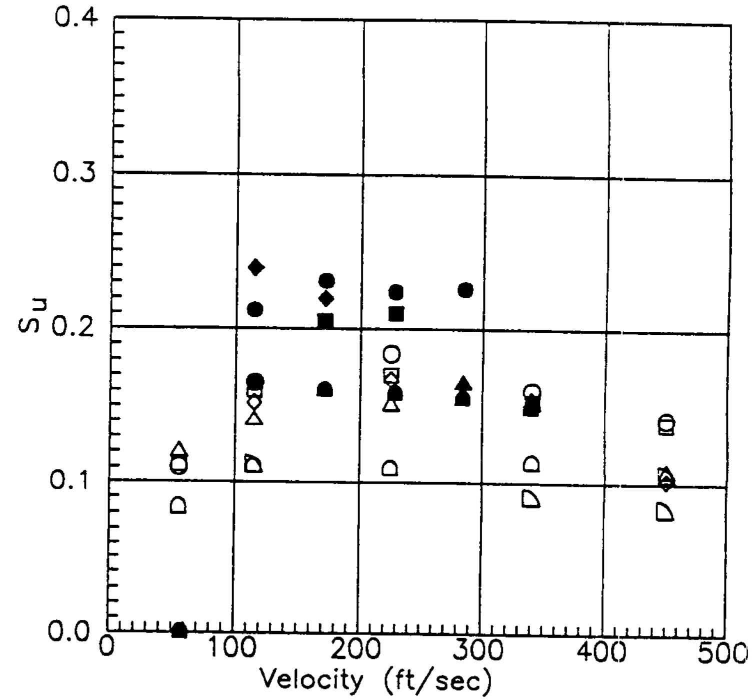

Figure 21.2 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, Y-wire, To = 80 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
◗	0.037	ꓷ	0.012
▲	0.074	◇	0.015
■	0.142	Ɑ	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

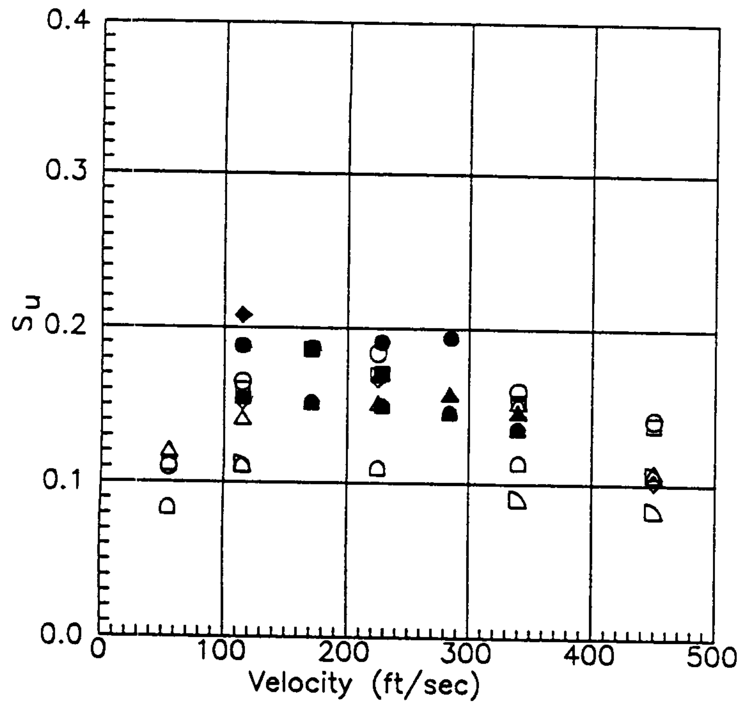

Figure 21.3 Velocity vs. S(U) Nut = f(M,Kn, ω), local fit
dw = 0.00015 inch, Y–wire, To = 80 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

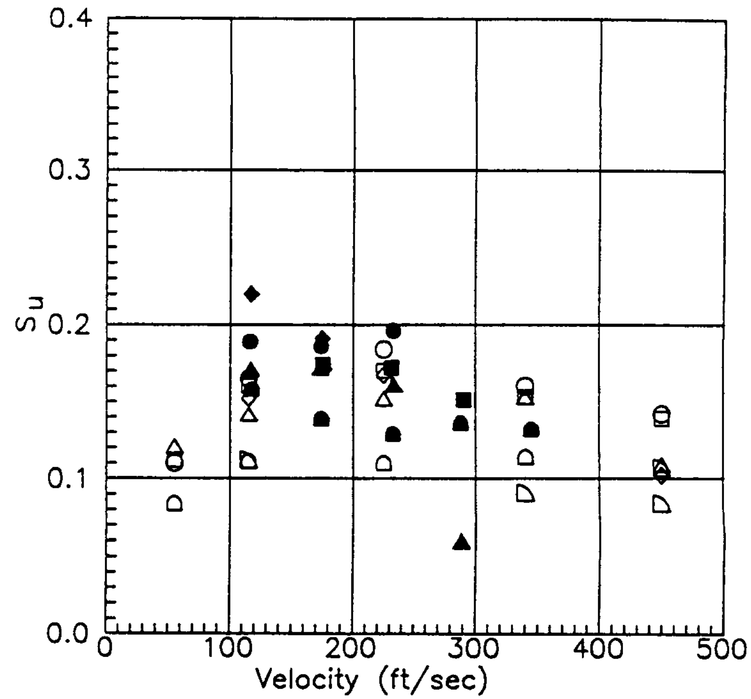

Figure 21.4 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, Y–wire, To = 100

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

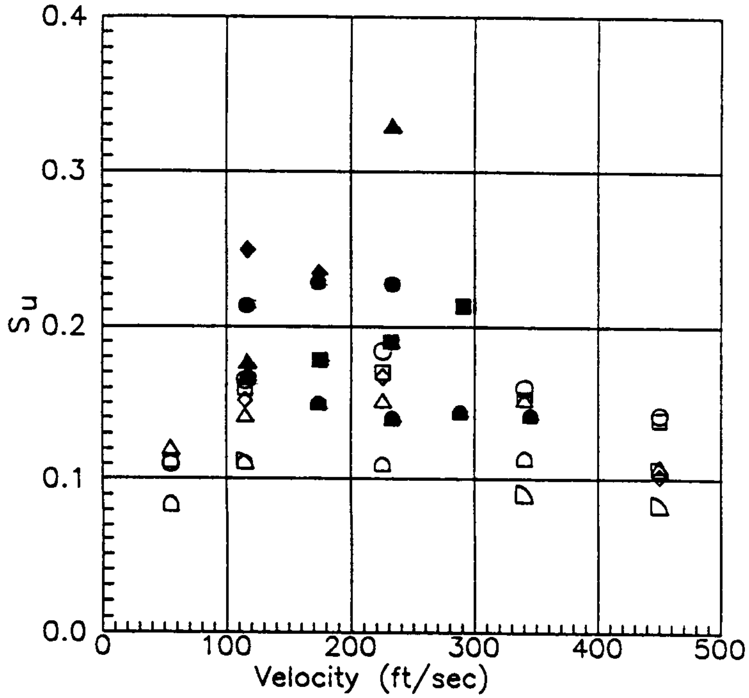

Figure 21.5 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, Y-wire, To = 100

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

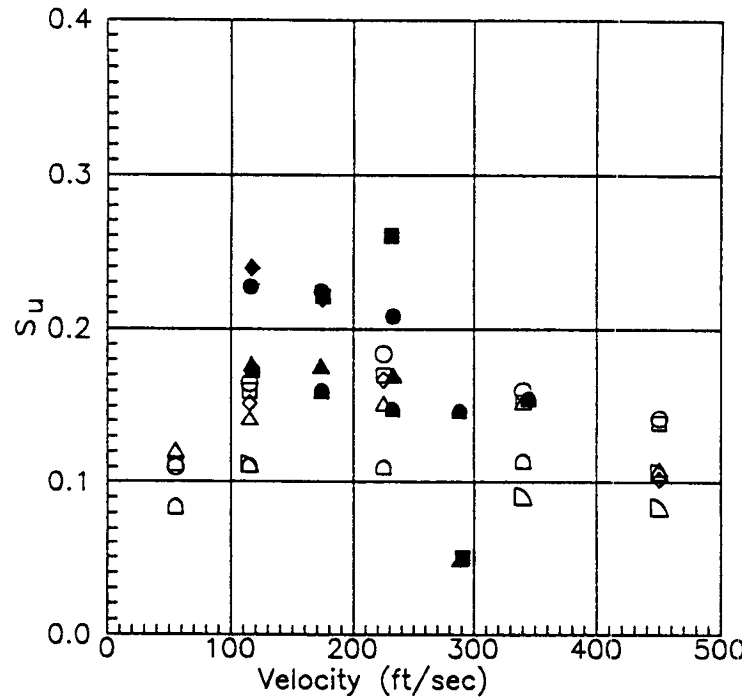

Figure 21.6 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, Y-wire, To = 100

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

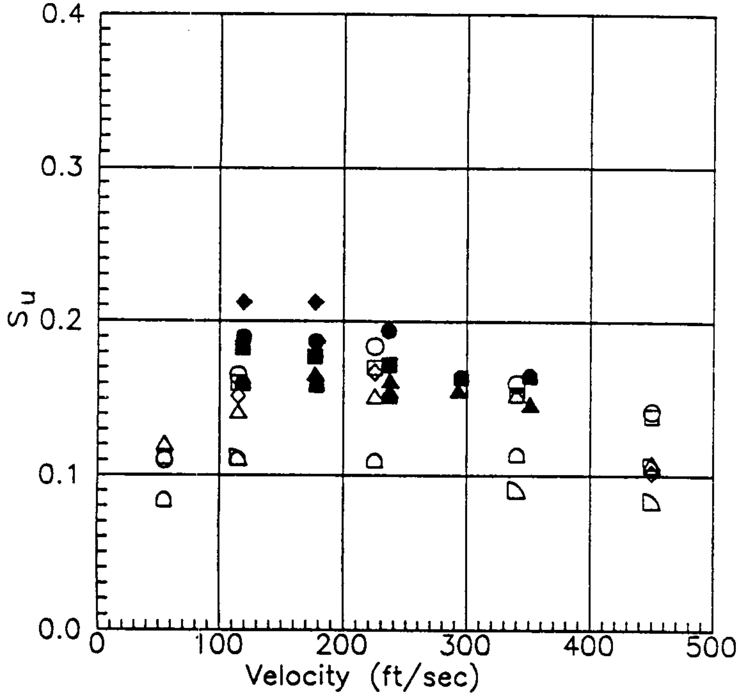

Figure 21.7 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, Y–wire, To = 120

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	D	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

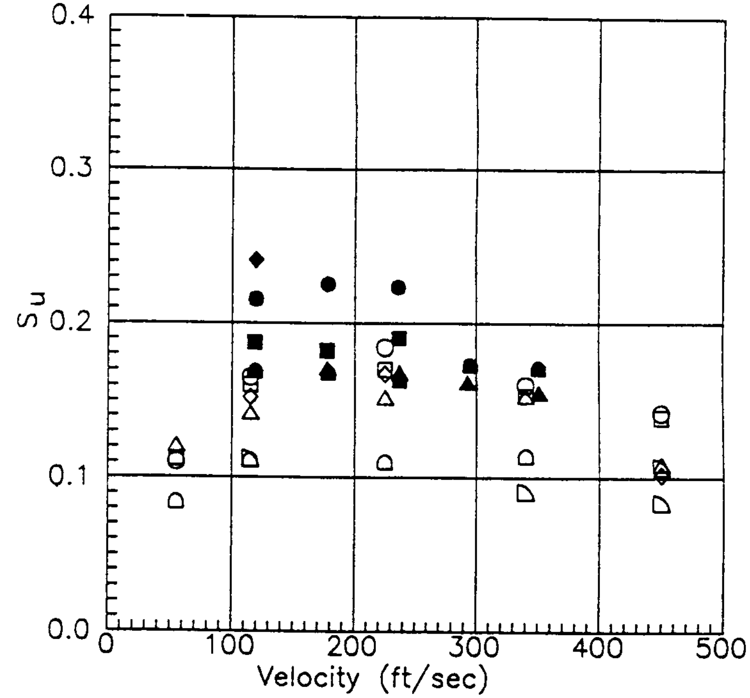

Figure 21.8 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, Y–wire, To = 120

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	D	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

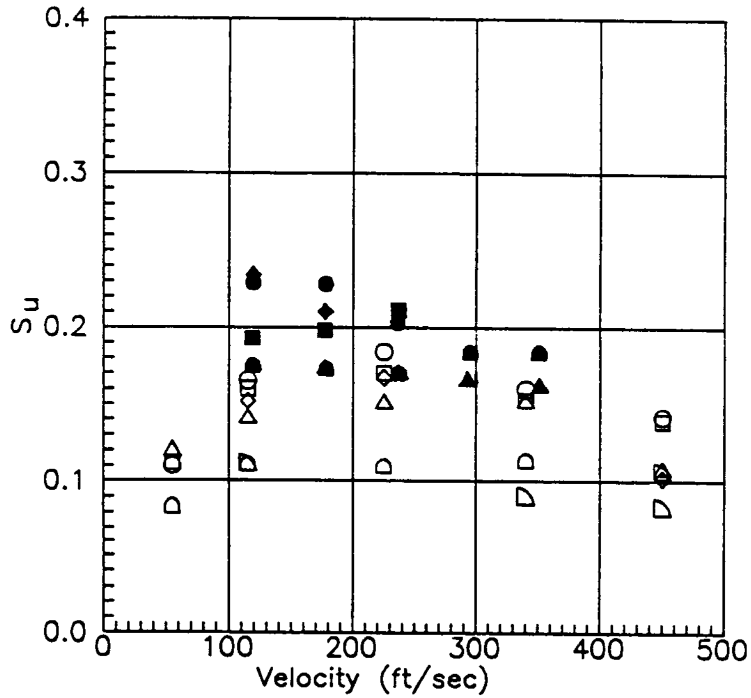

Figure 21.9 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, Y-wire, To = 120

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

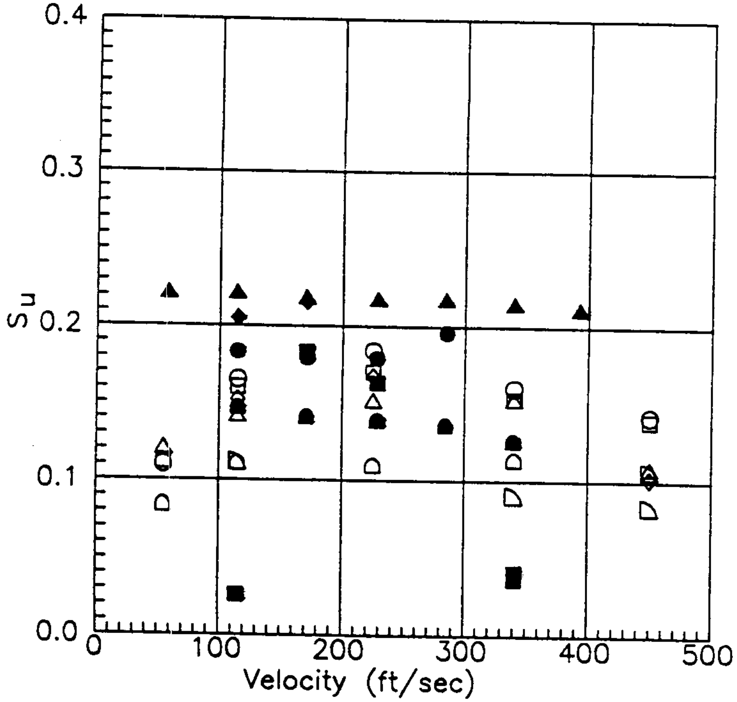

Figure 22.1 Velocity vs. S(U), E = f(U,ρ,To), local fit
dw = 0.00015 inch, S-wire, To = 80

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
☗	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

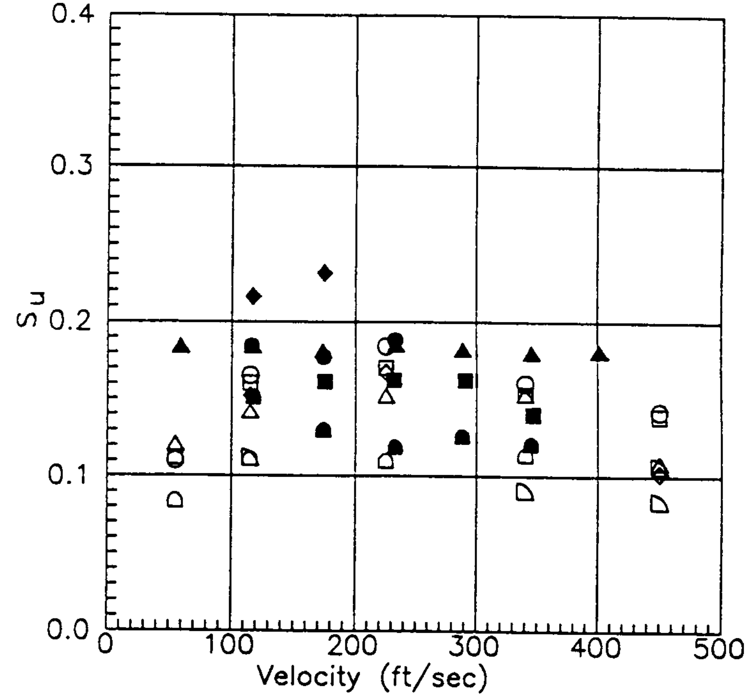

Figure 22.2 Velocity vs. S(U), E = f(U,ρ,To), local fit
dw = 0.00015 inch, S-wire, To = 100

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
☗	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

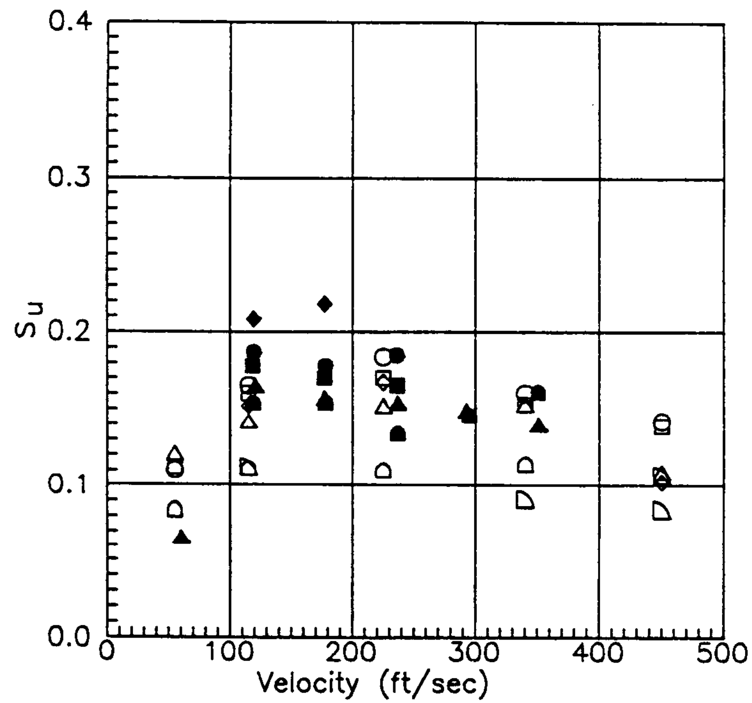

Figure 22.3 Velocity vs. S(U), E = f(U,ρ,To), local fit
dw = 0.00015 inch, S-wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

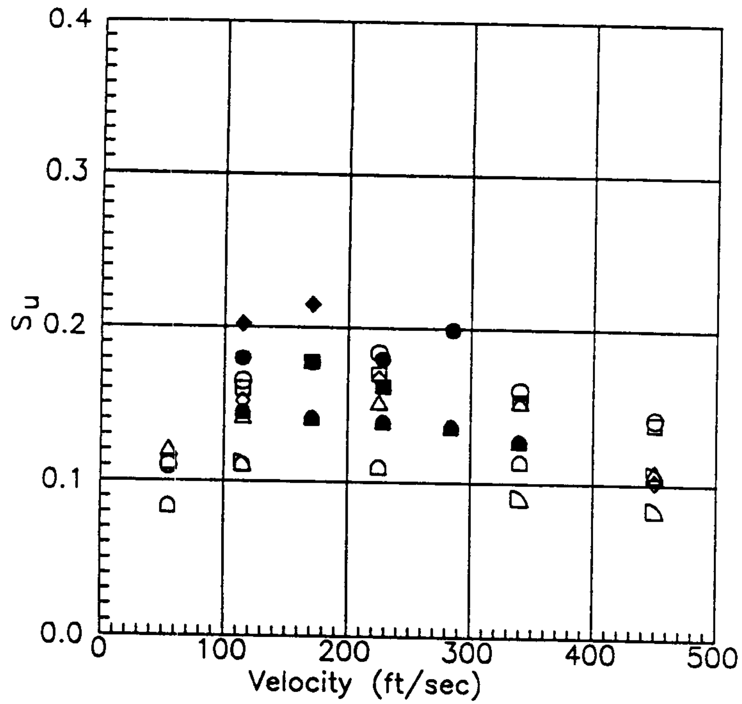

Figure 23.1 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, S-wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

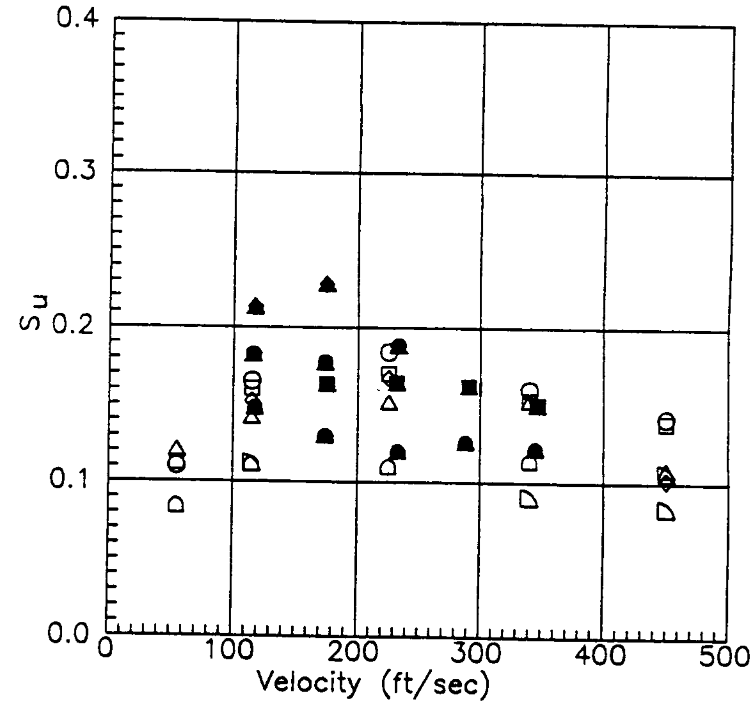

Figure 23.2 Velocity vs. S(U), Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, S-wire, To = 100

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

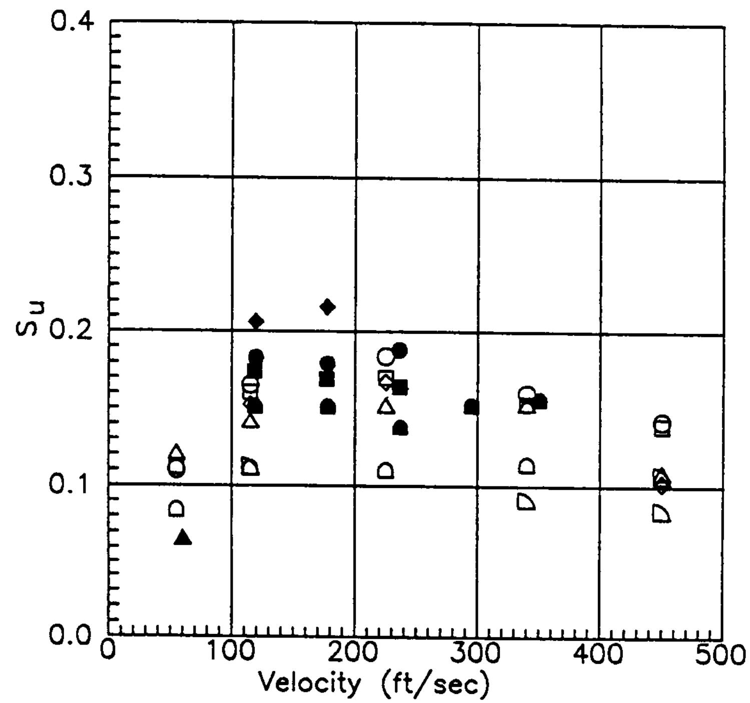

Figure 23.3 Velocity vs. S(U), Nut = f(M,Kn,), local fit
dw = 0.00015 inch, S-wire, To = 120

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

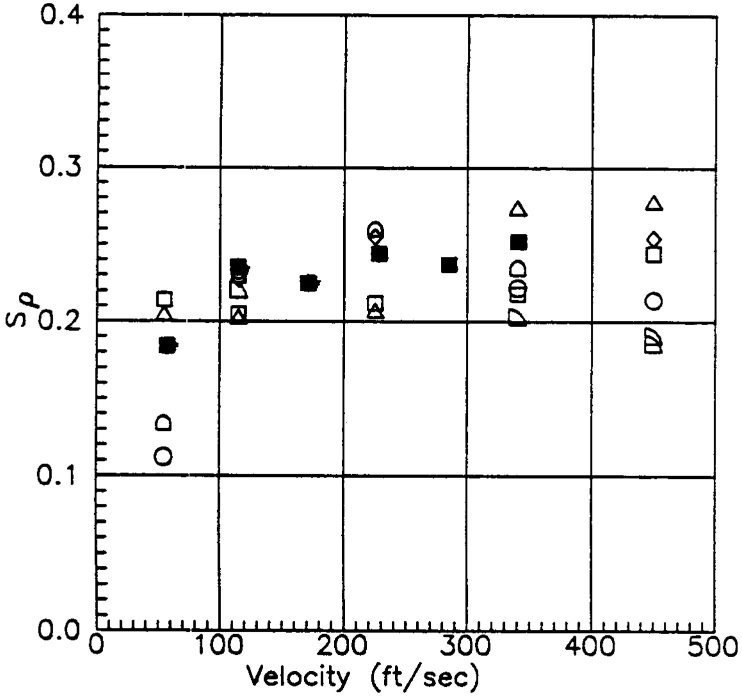

Figure 24.1 Velocity vs. S_ρ, E = f(U,ρ,To), local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 80
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

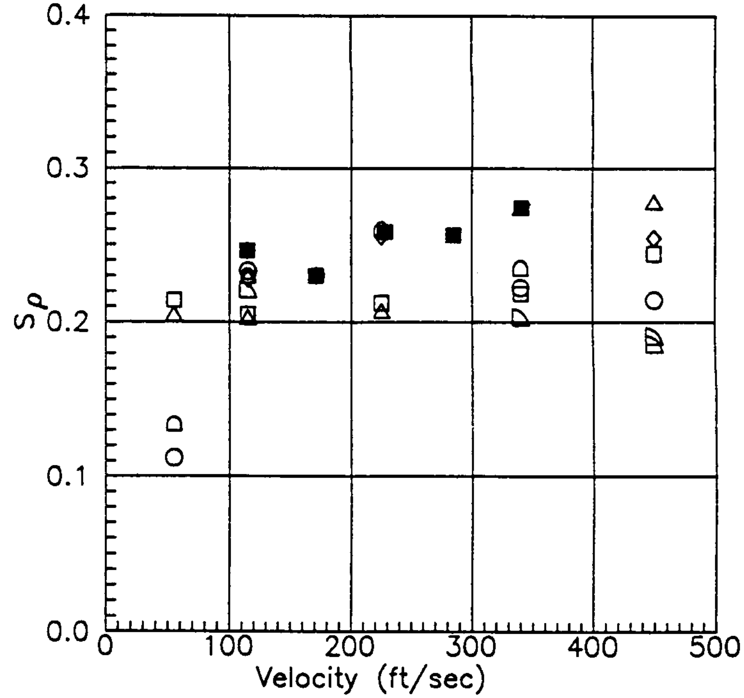

Figure 24.2 Velocity vs. S_ρ, E = f(U,ρ,To), local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

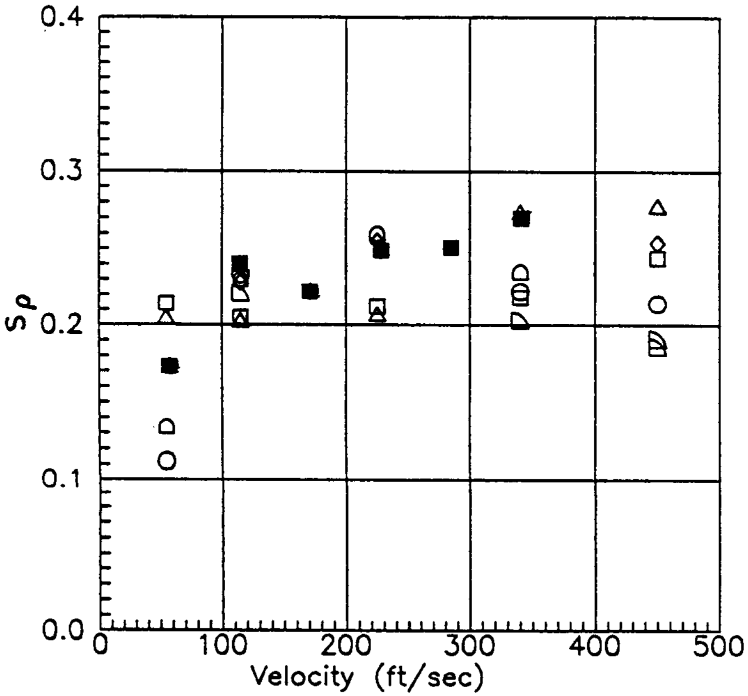

Figure 24.3 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

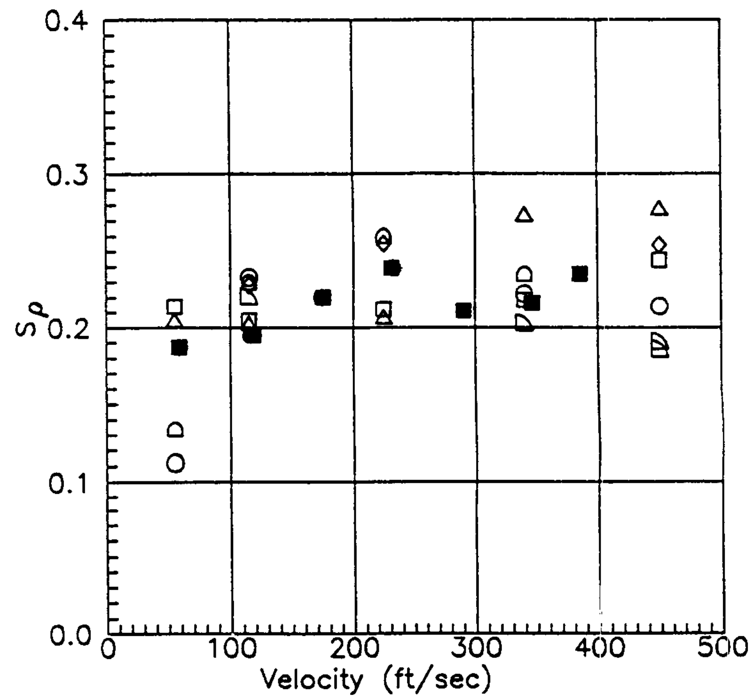

Figure 24.4 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

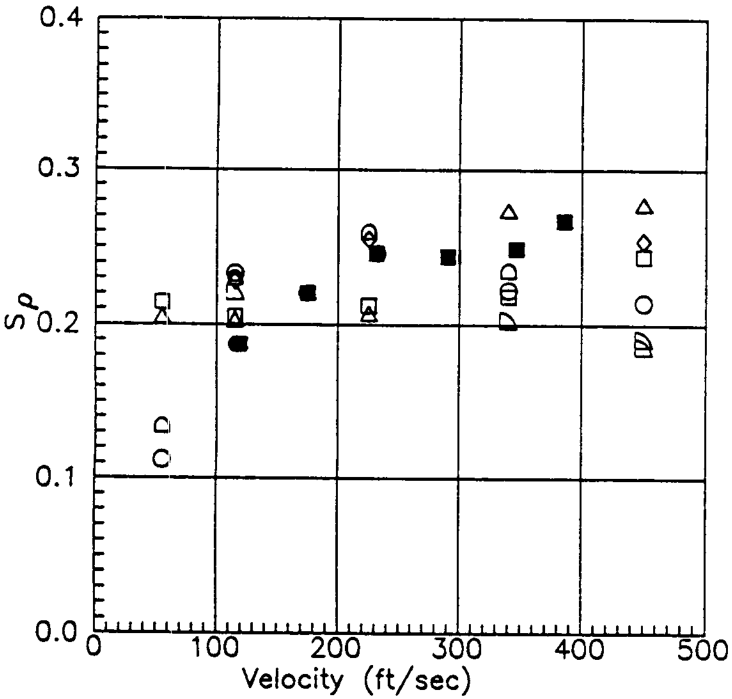

Figure 24.5 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ
dw = 0.00032 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

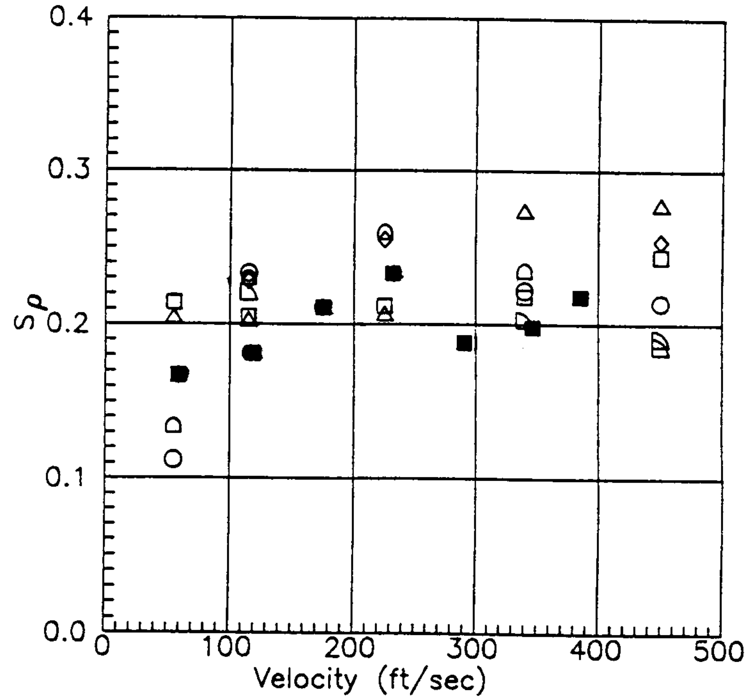

Figure 24.6 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

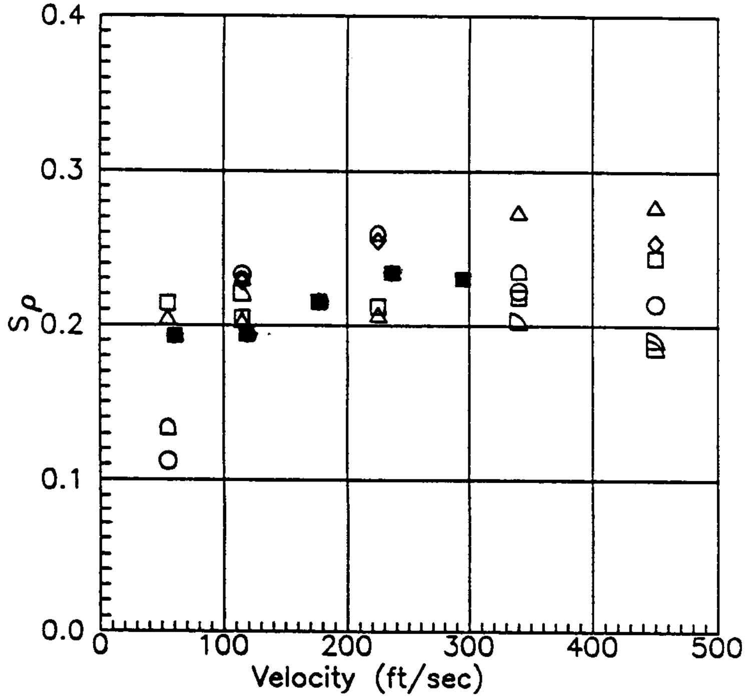

Figure 24.7 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

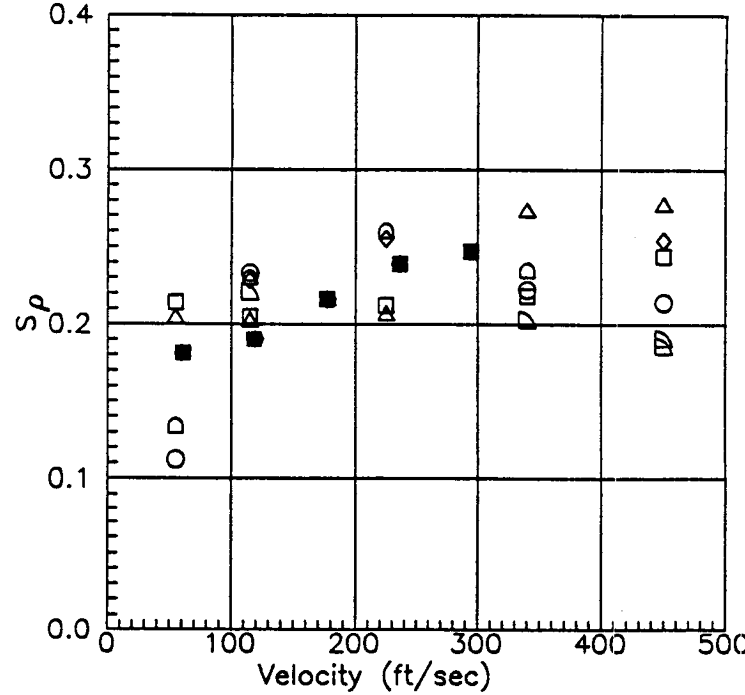

Figure 24.8 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

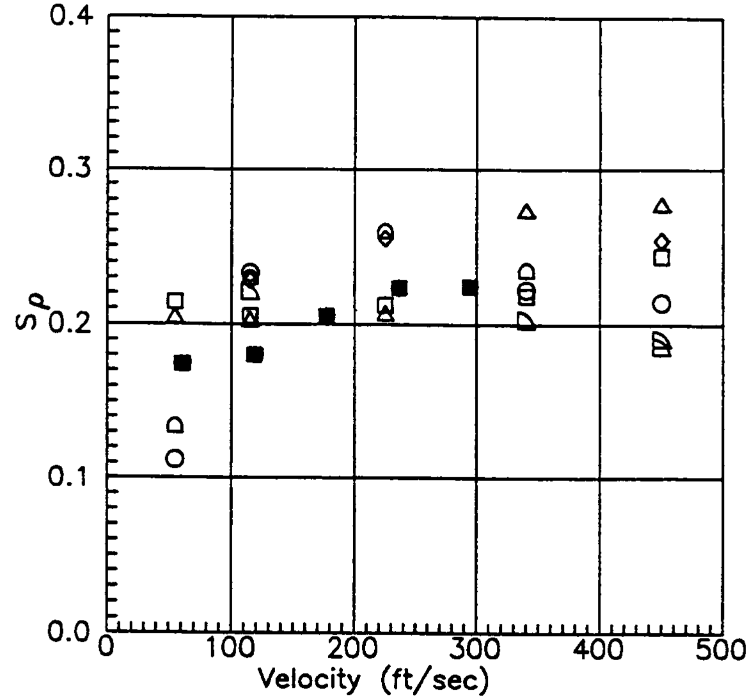

Figure 24.9 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

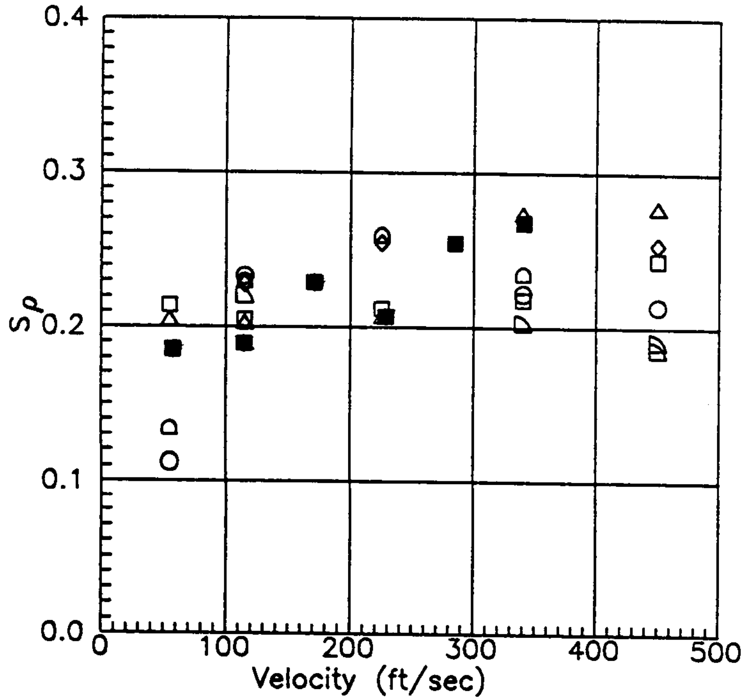

Figure 25.1 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 80
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
⬟	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

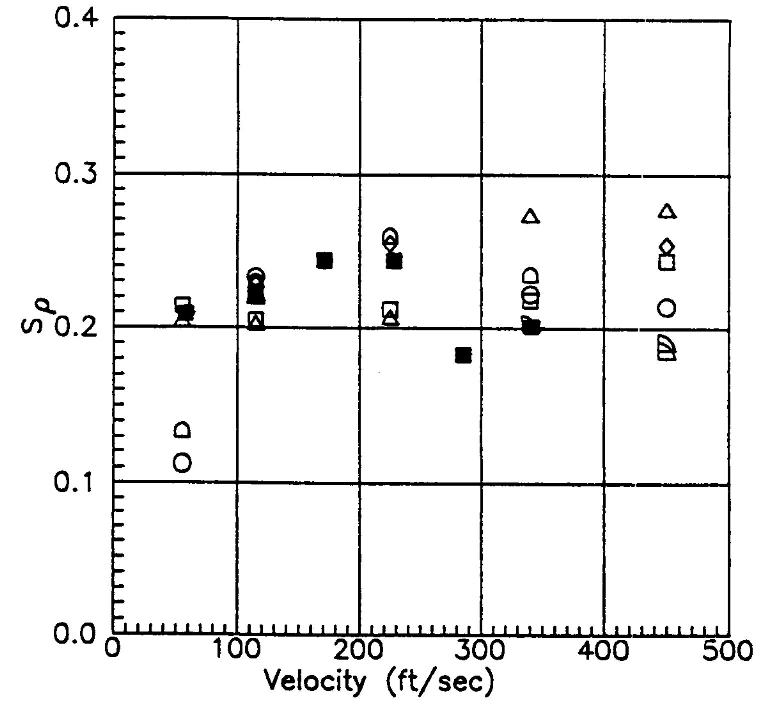

Figure 25.2 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 80
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
⬟	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

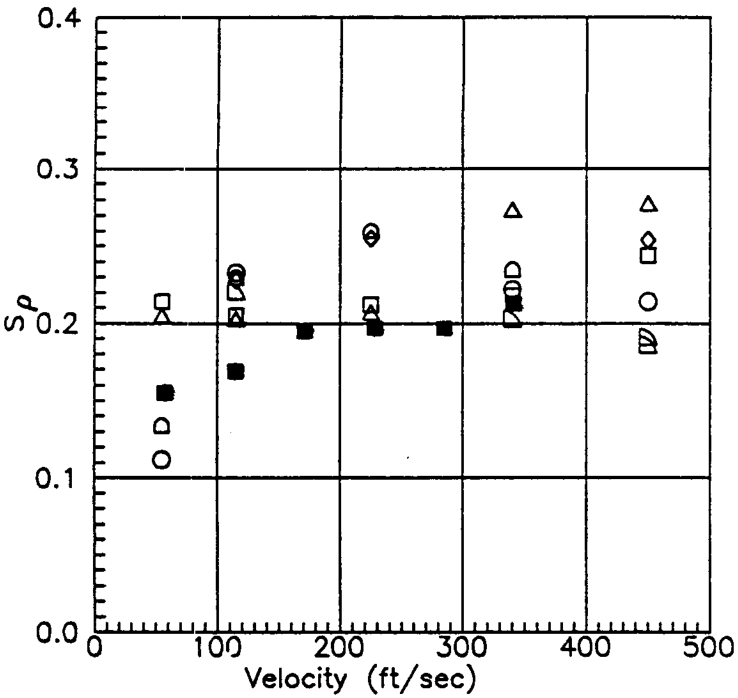

Figure 25.3 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 80
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

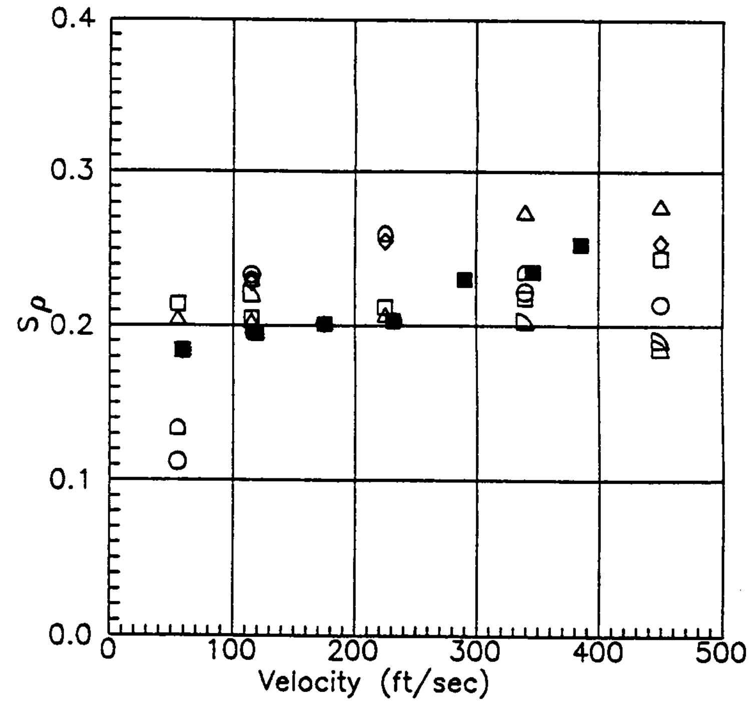

Figure 25.4 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

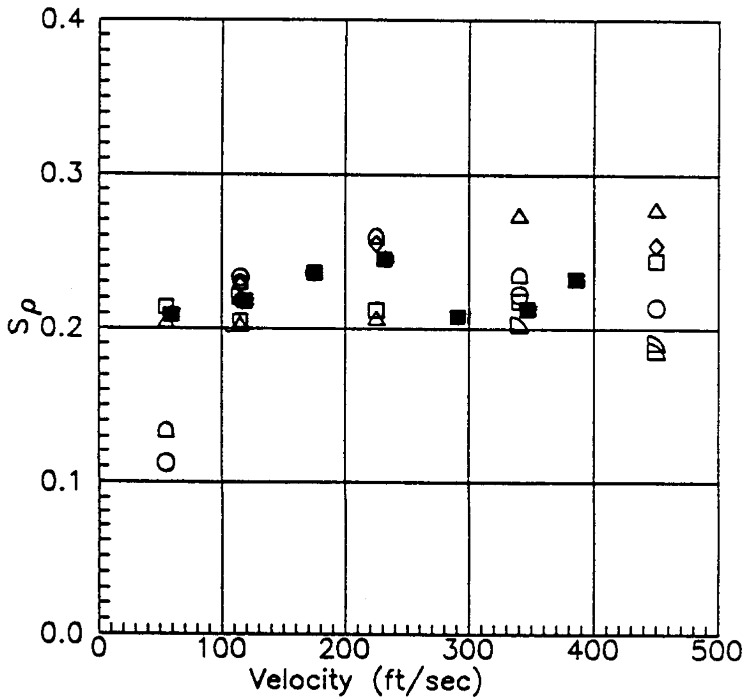

Figure 25.5 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
⬟	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

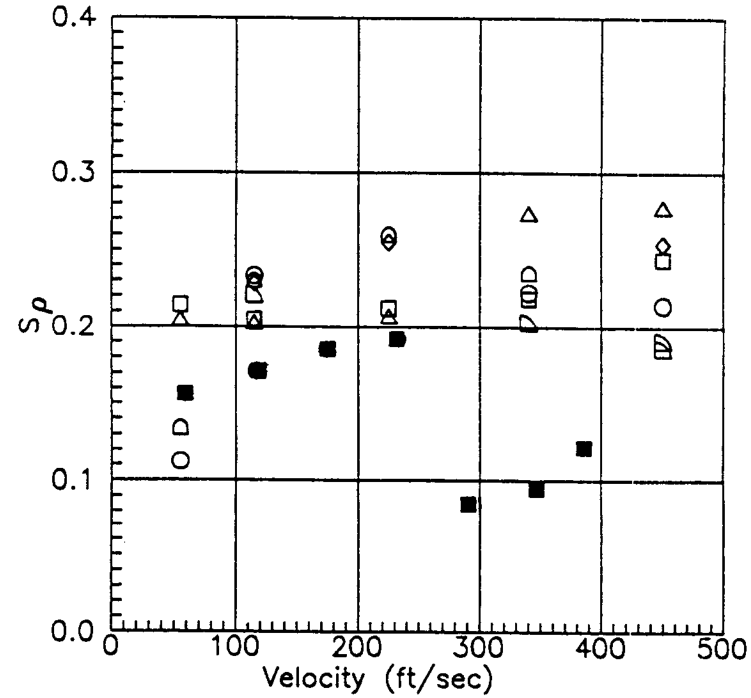

Figure 25.6 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 100
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
⬟	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

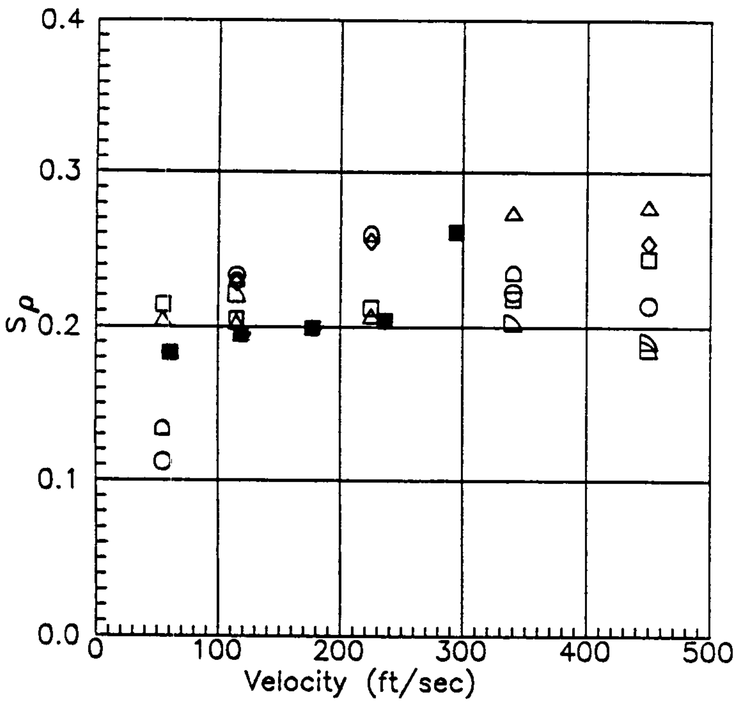

Figure 25.7 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

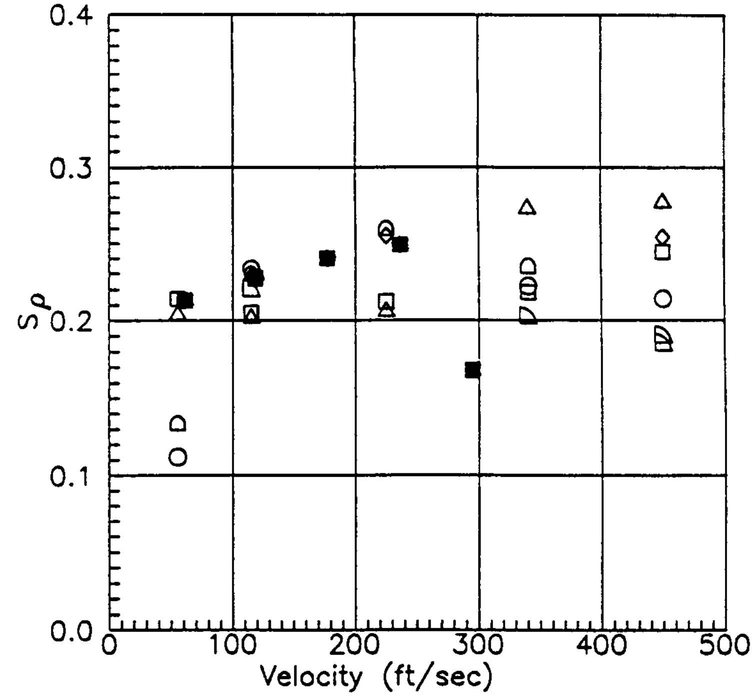

Figure 25.8 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

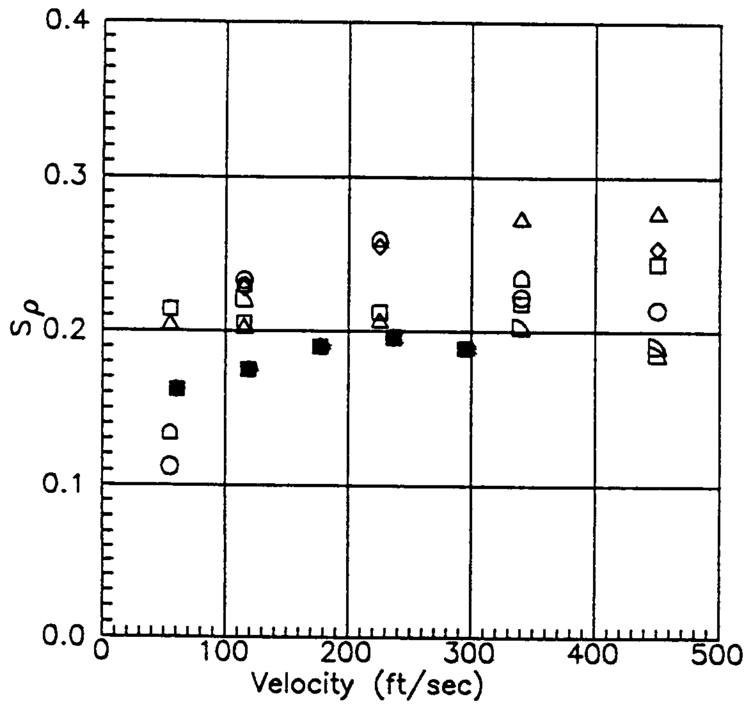

Figure 25.9 Velocity vs. S_ρ. Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 120
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

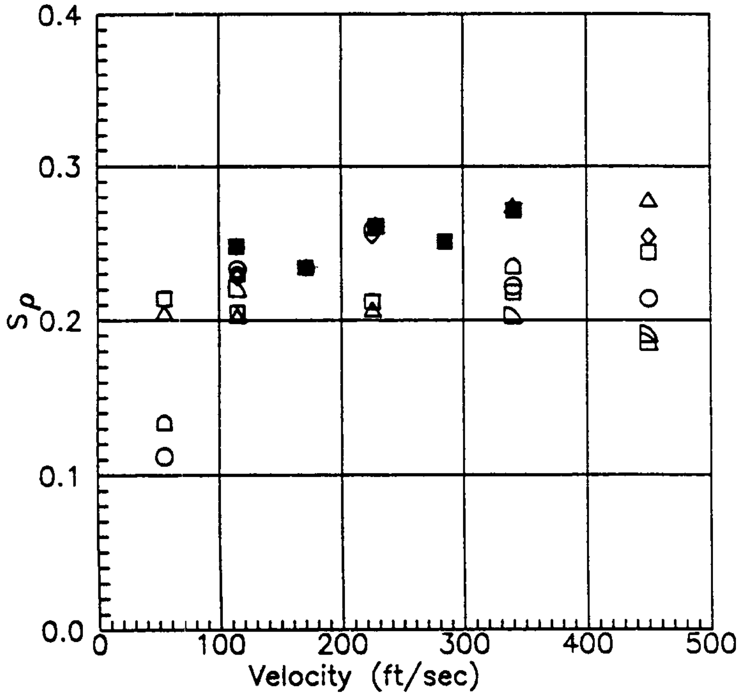

Figure 26.1 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
⬟	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

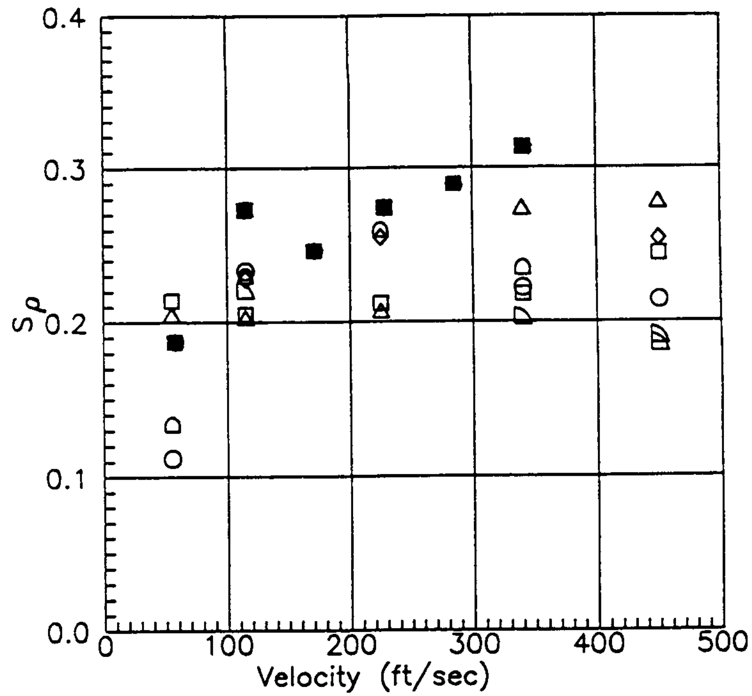

Figure 26.2 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
⬟	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

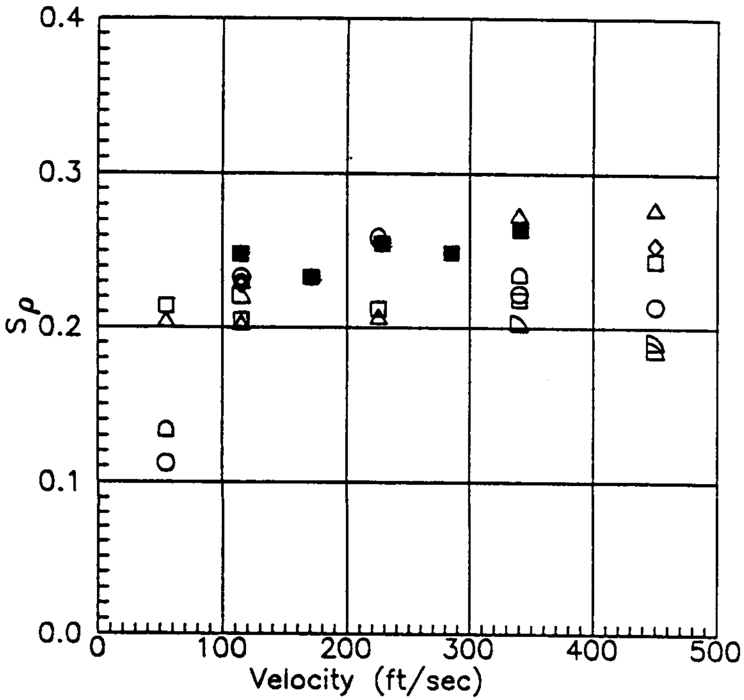

Figure 26.3 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00050 inch, Y-wire, To = 80 F

Symbols:

Present	Density, #/ft³	Baldwin	Density, #/ft³
▶	0.037	▷	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

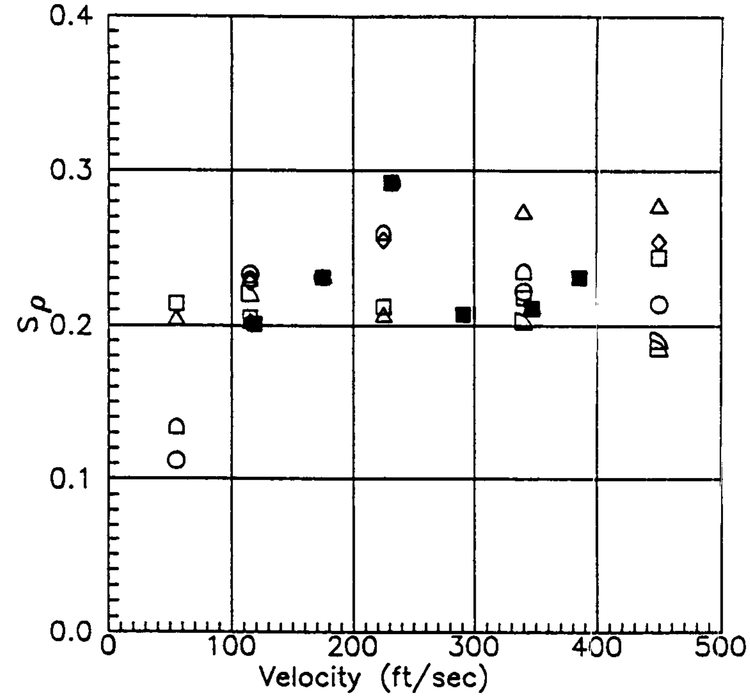

Figure 26.4 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y-wire, To = 100 F

Symbols:

Present	Density, #/ft³	Baldwin	Density, #/ft³
●	0.037	▷	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

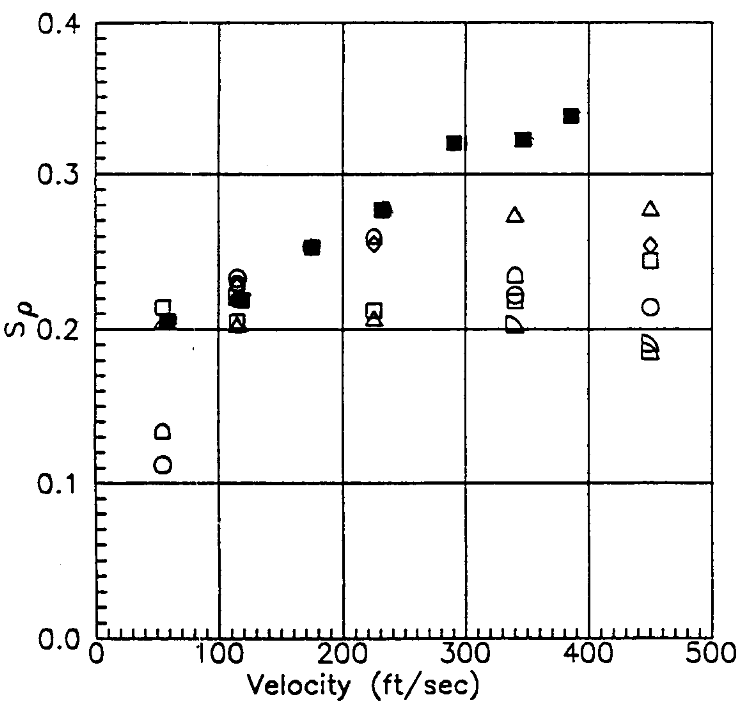

Figure 26.5 Velocity vs. S_ρ, $E = f(U,\rho,T_o)$, local fit (E vs. ρ, linear fit in log–log space for S_ρ) dw = 0.00032 inch, Y-wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

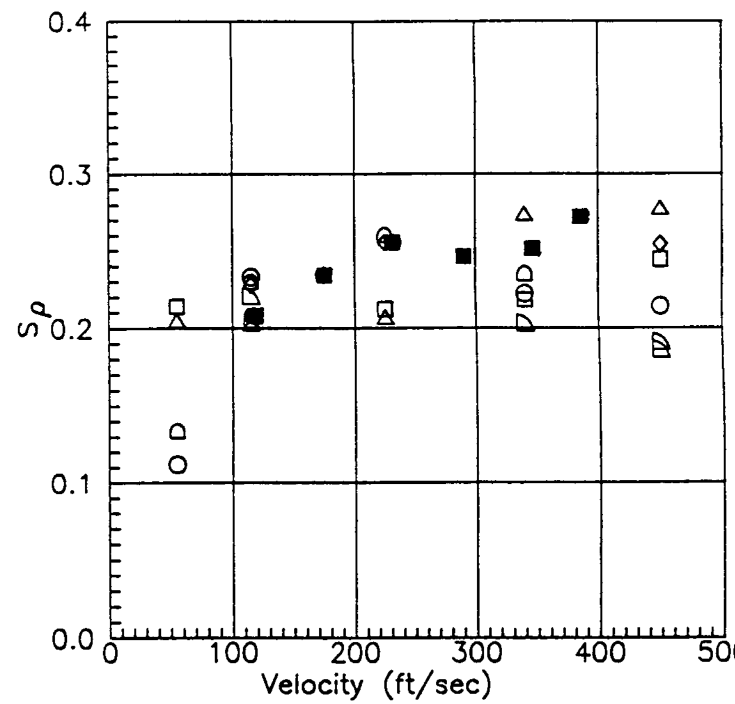

Figure 26.6 Velocity vs. S_ρ, $E = f(U,\rho,T_o)$, local fit (E vs. ρ, linear fit in log–log space for S_ρ) dw = 0.00050 inch, Y-wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

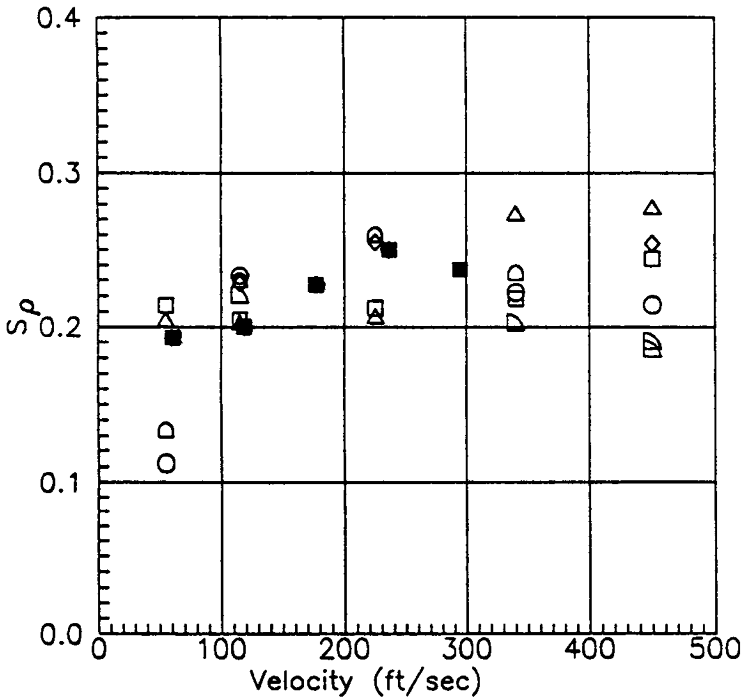

Figure 26.7 Velocity vs. S_ρ, E = f(U,ρ,To), local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

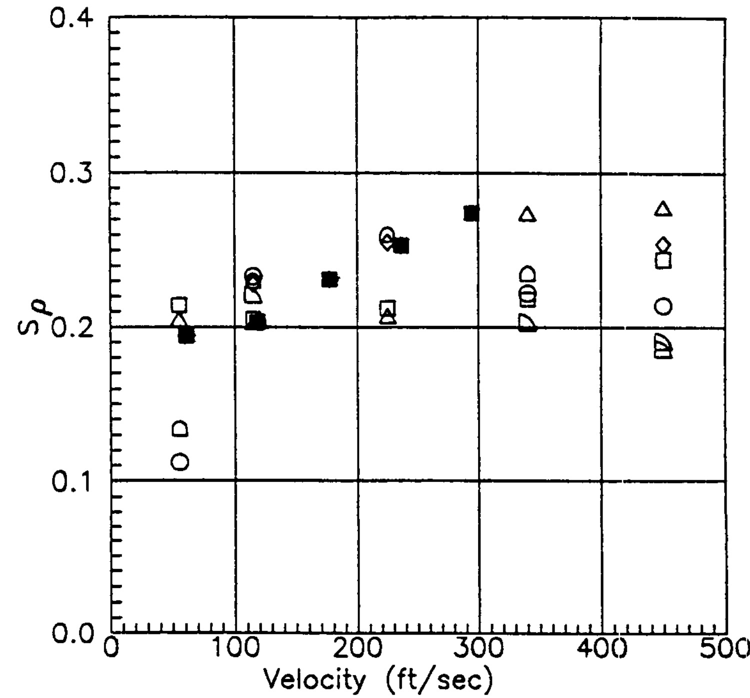

Figure 26.8 Velocity vs. S_ρ, E = f(U,ρ,To), local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

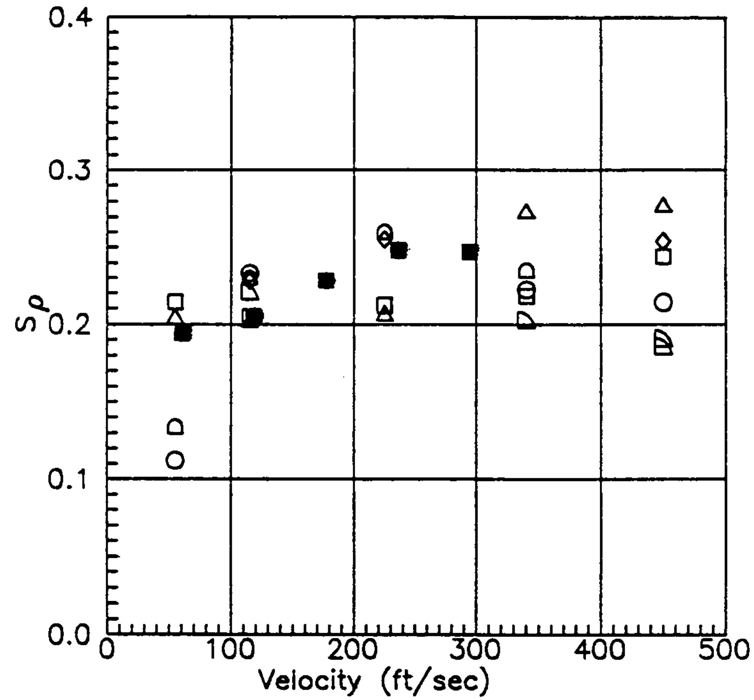

Figure 26.9 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00050 inch, Y-wire, To = 120 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

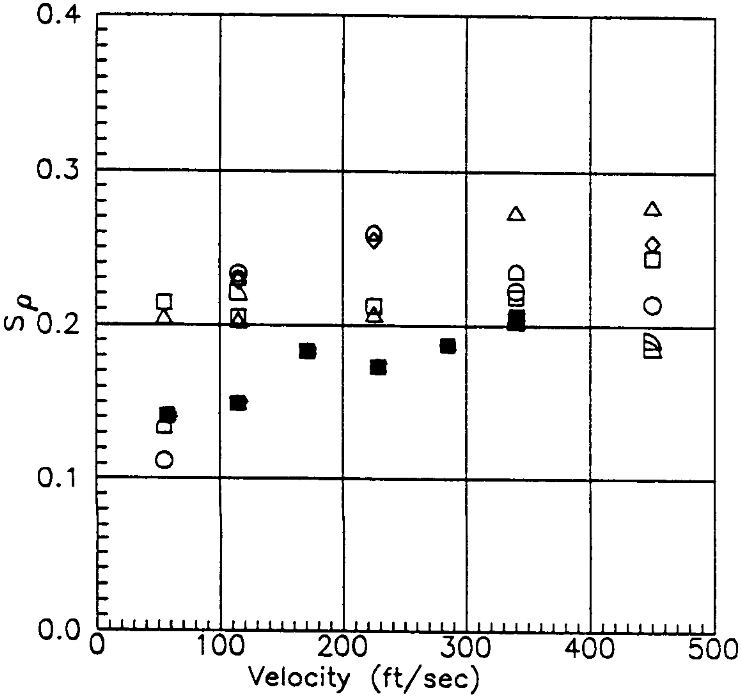

Figure 27.1 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit (Nut vs. Kn, linear fit in log–log space for S_ρ) dw = 0.00015 inch, Y–wire, To = 80

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

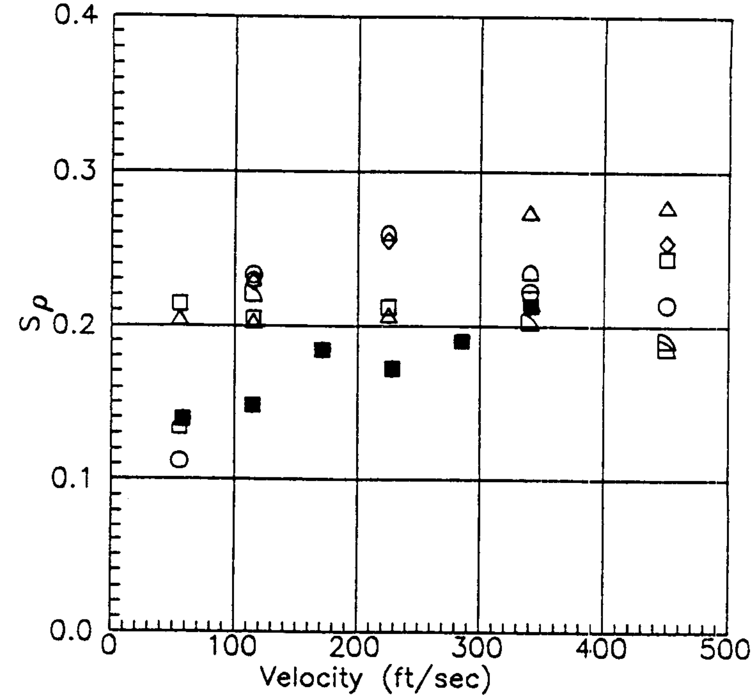

Figure 27.2 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit (Nut vs. Kn, linear fit in log–log space for S_ρ) dw = 0.00032 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

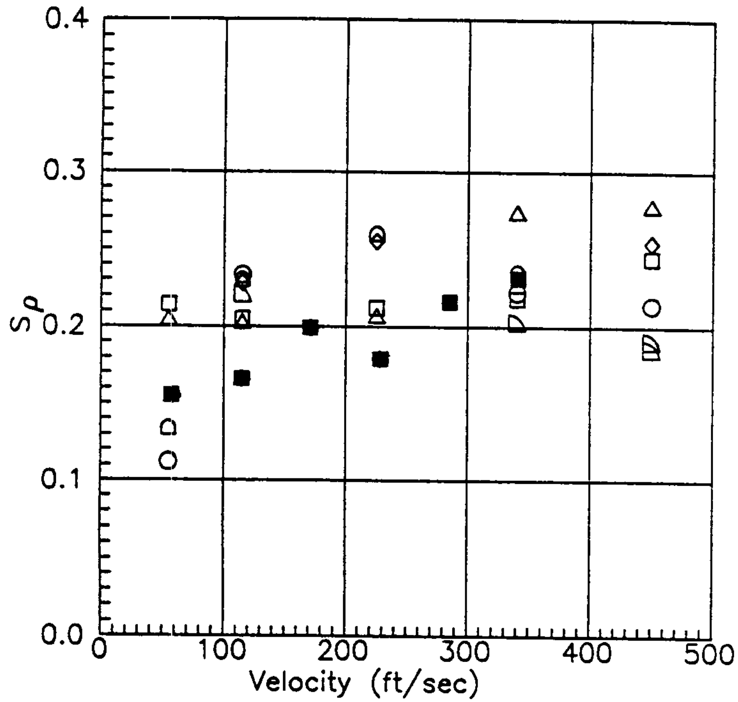

Figure 27.3 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit (Nut vs. Kn, linear fit in log–log space for S_ρ) dw = 0.00050 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

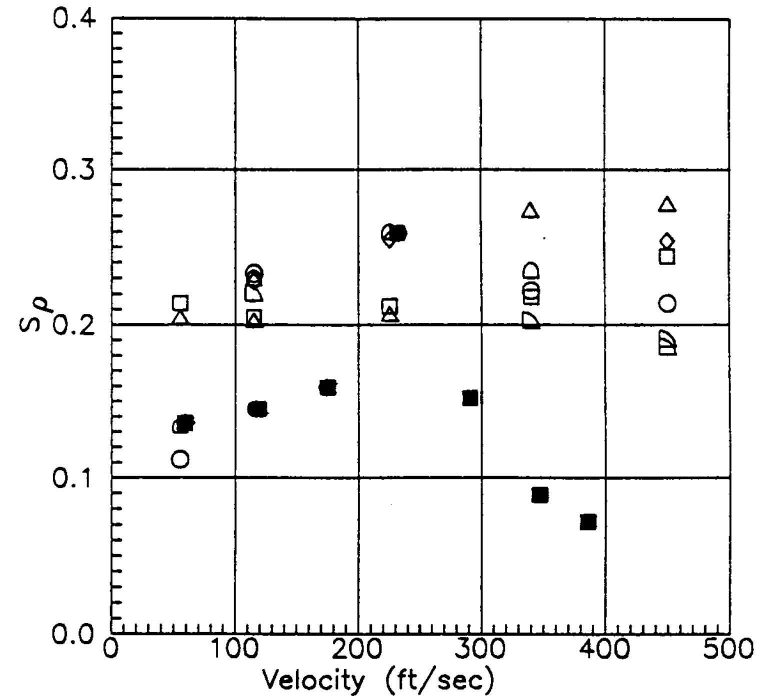

Figure 27.4 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit (Nut vs. Kn, linear fit in log–log space for S_ρ) dw = 0.00015 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

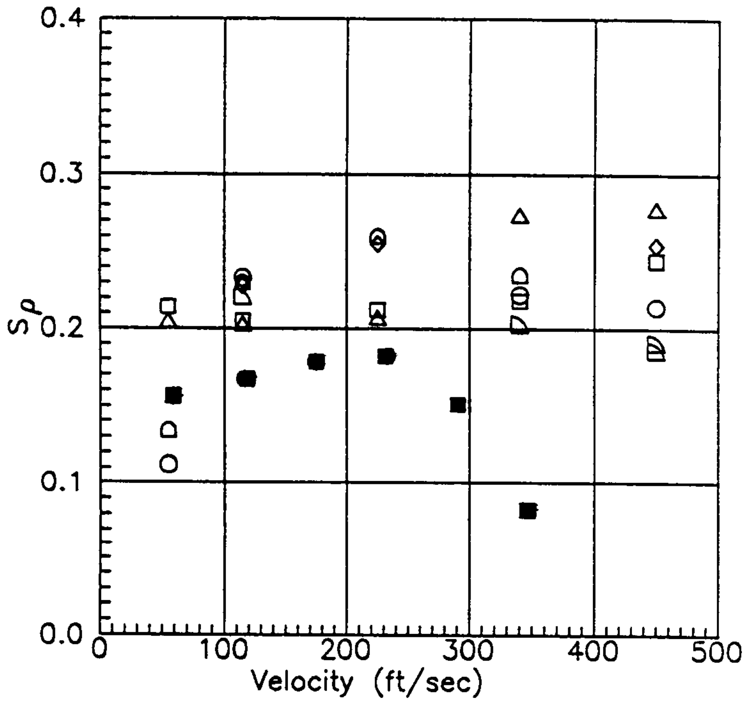

Figure 27.5 Velocity vs. S_ρ. Nut = f(M,Kn,τ), local fit (Nut vs. Kn, linear fit in log–log space for S_ρ) dw = 0.00032 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◖	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

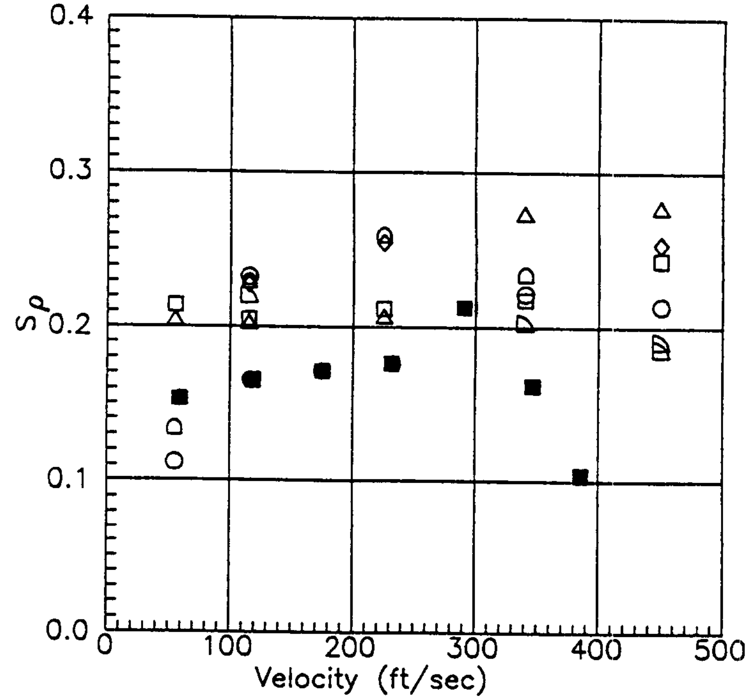

Figure 27.6 Velocity vs. S_ρ. Nut = f(M,Kn,τ), local fit (Nut vs. Kn, linear fit in log–log space for S_ρ) dw = 0.00050 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◖	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

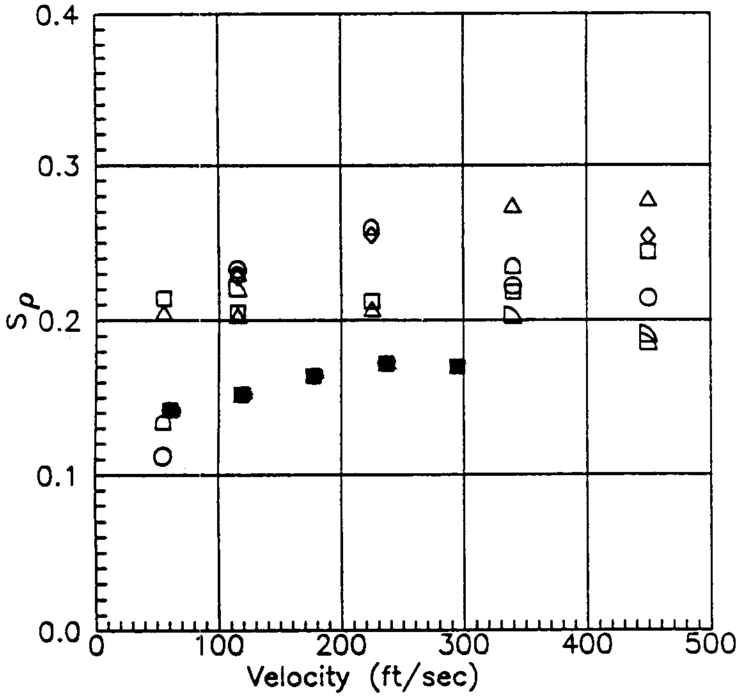

Figure 27.7 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 120 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

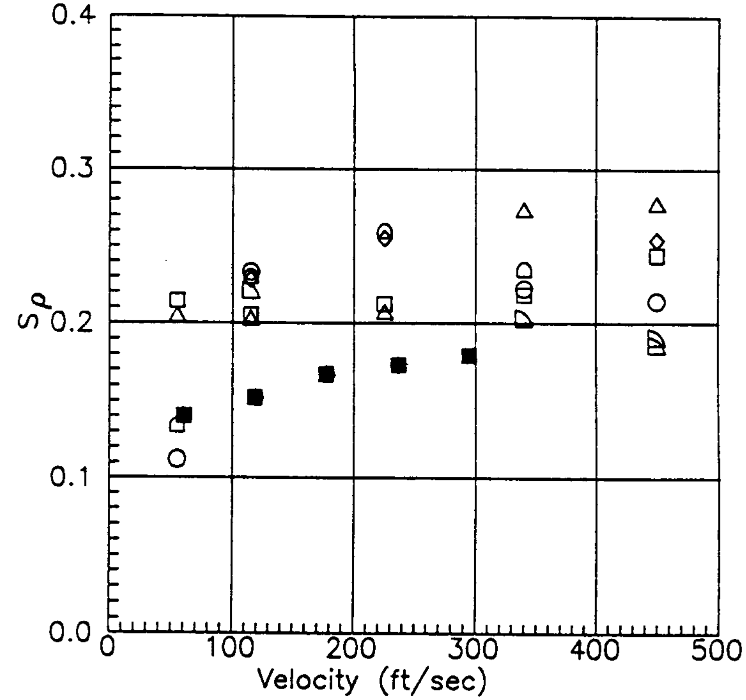

Figure 27.8 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 120 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

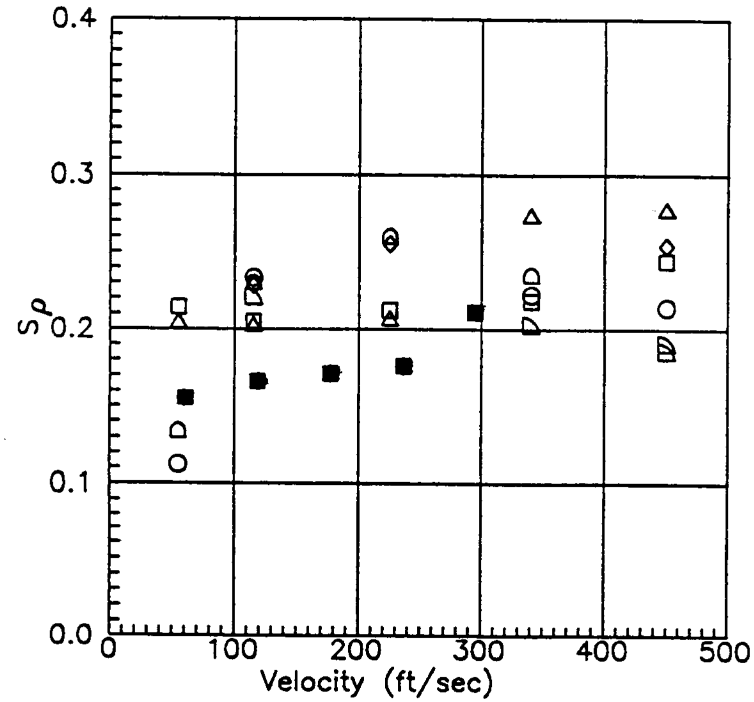

Figure 27.9 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit (Nut vs. Kn, linear fit in log–log space for S_ρ) dw = 0.00050 inch, Y–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
⬢	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

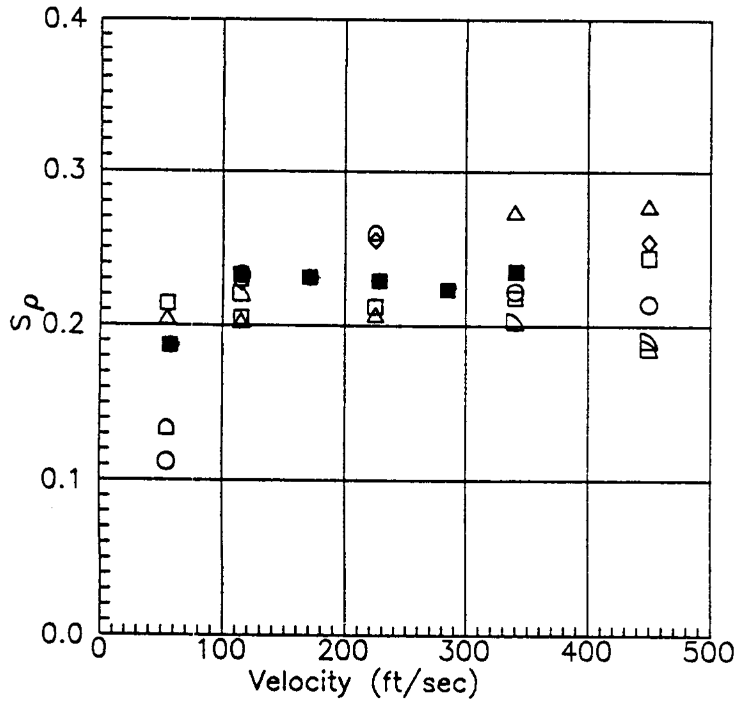

Figure 28.1 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 80 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

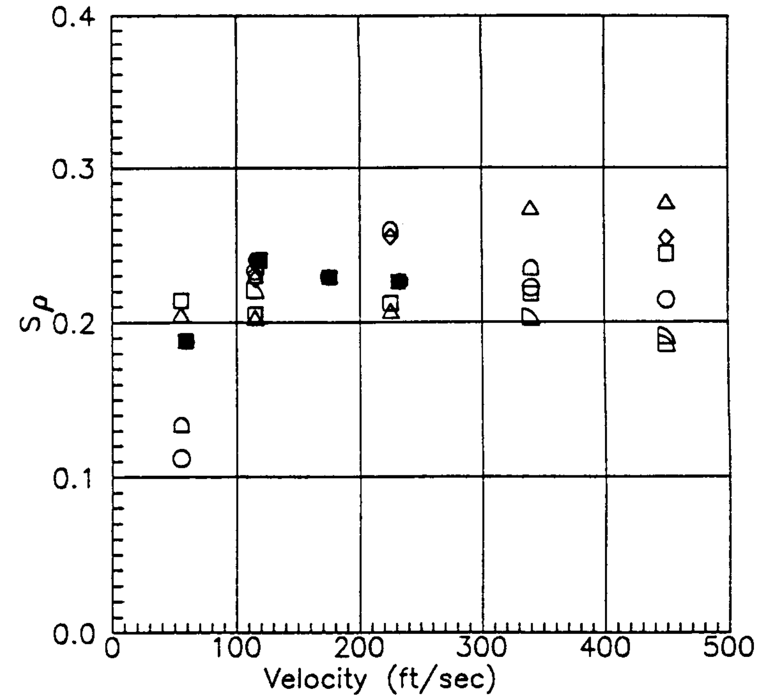

Figure 28.2 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 100 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

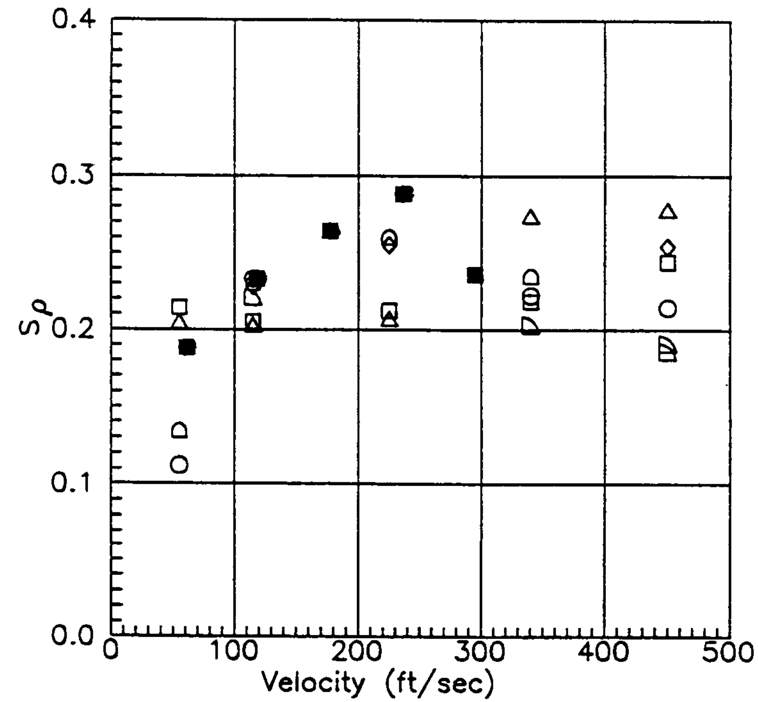

Figure 28.3 Velocity vs. S_ρ, $E = f(U,\rho,To)$, local fit
(E vs. ρ, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
⬟	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◘	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

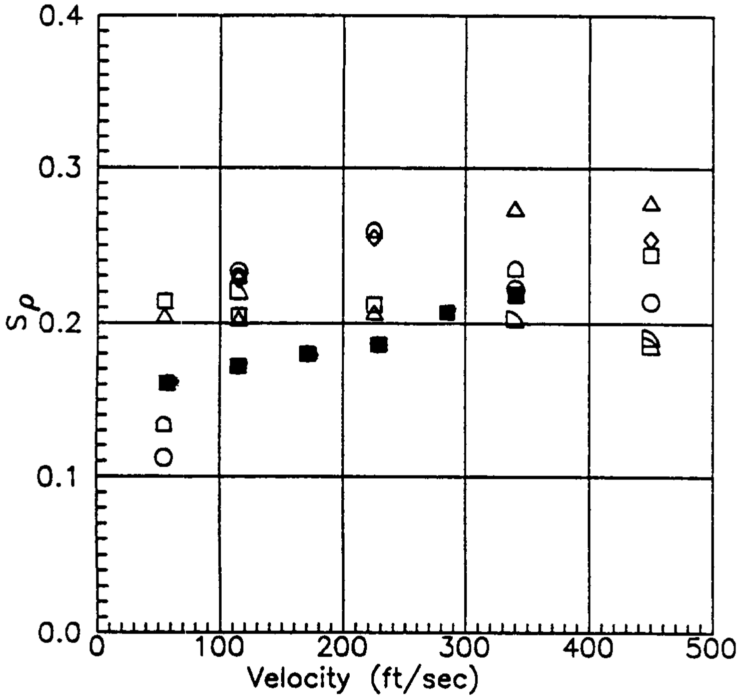

Figure 29.1 Velocity vs. S_ρ. Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 80 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
◗	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

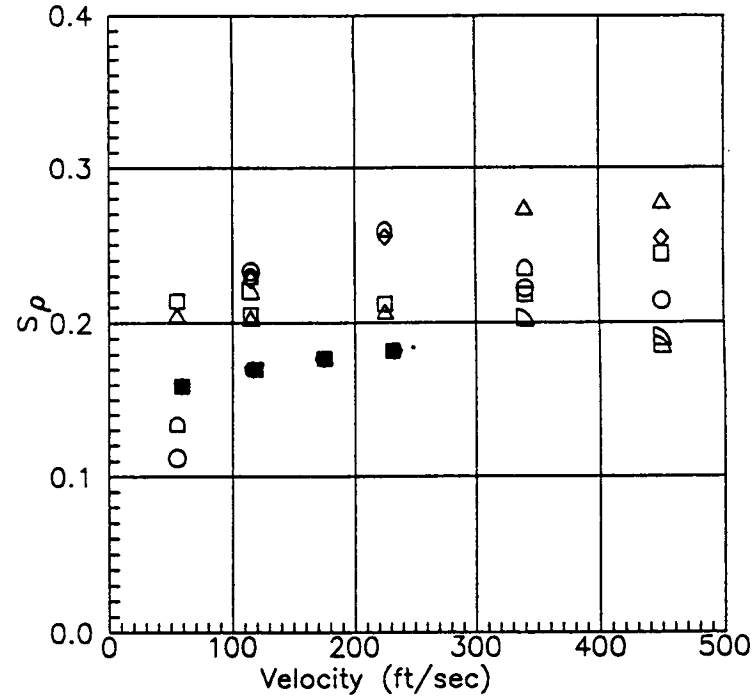

Figure 29.2 Velocity vs. S_ρ. Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 100 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
◗	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

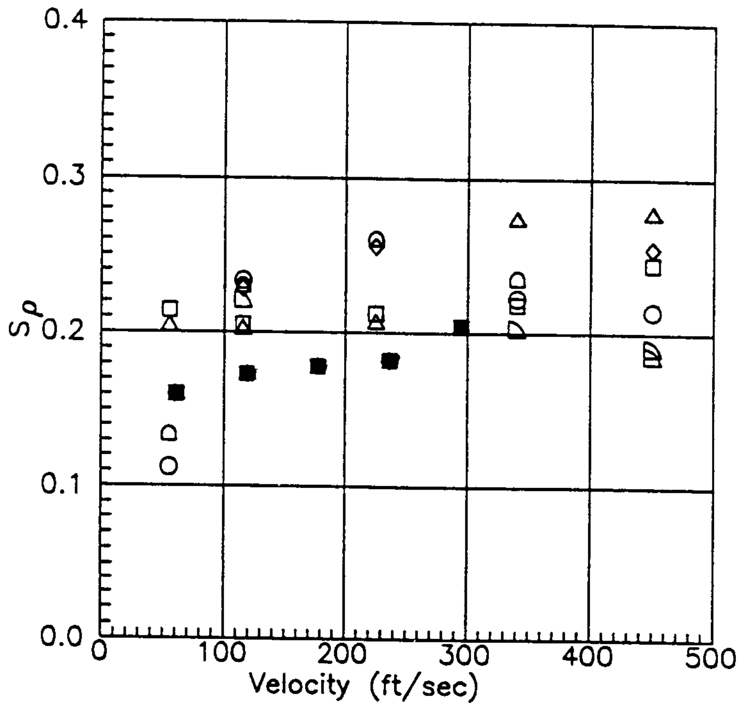

Figure 29.3 Velocity vs. S_ρ, Nut = f(M,Kn,τ), local fit (Nut vs. Kn, linear fit in log–log space for S_ρ) dw = 0.00015 inch, S–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

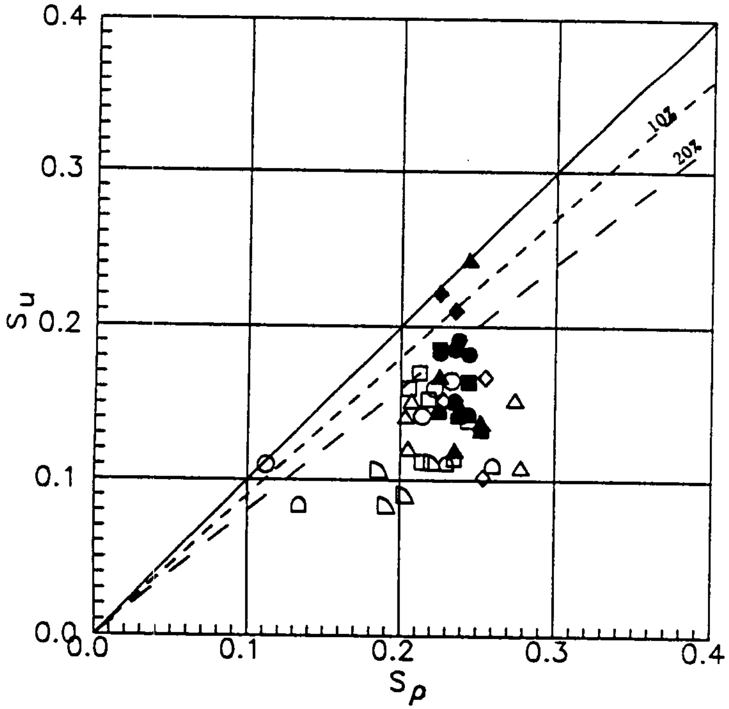

Figure 30.1 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

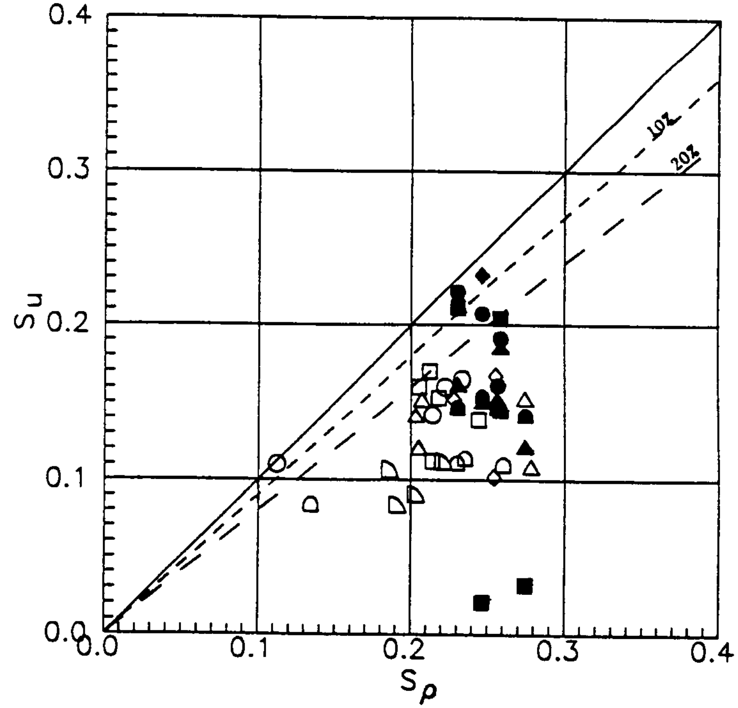

Figure 30.2 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

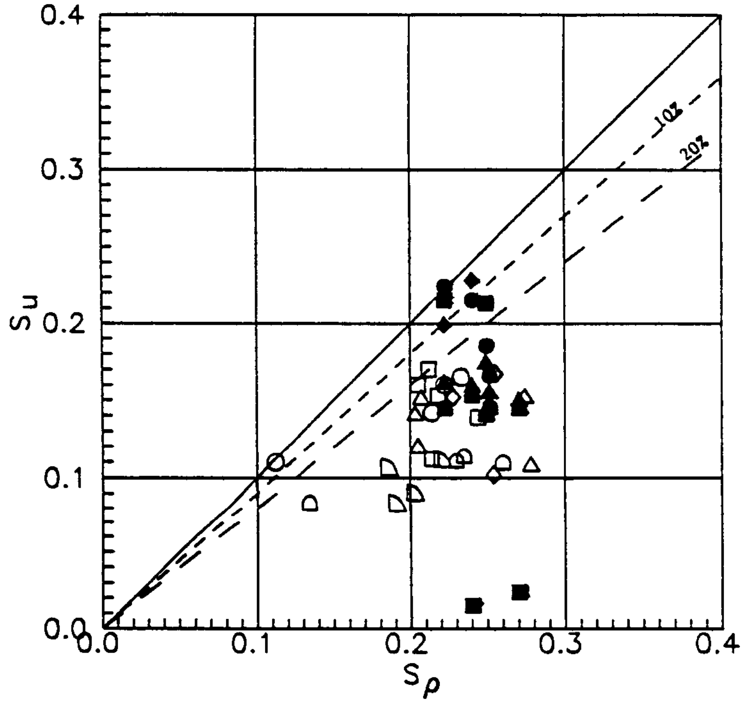

Figure 30.3 S_u vs. S_ρ, $E = f(U\rho, To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

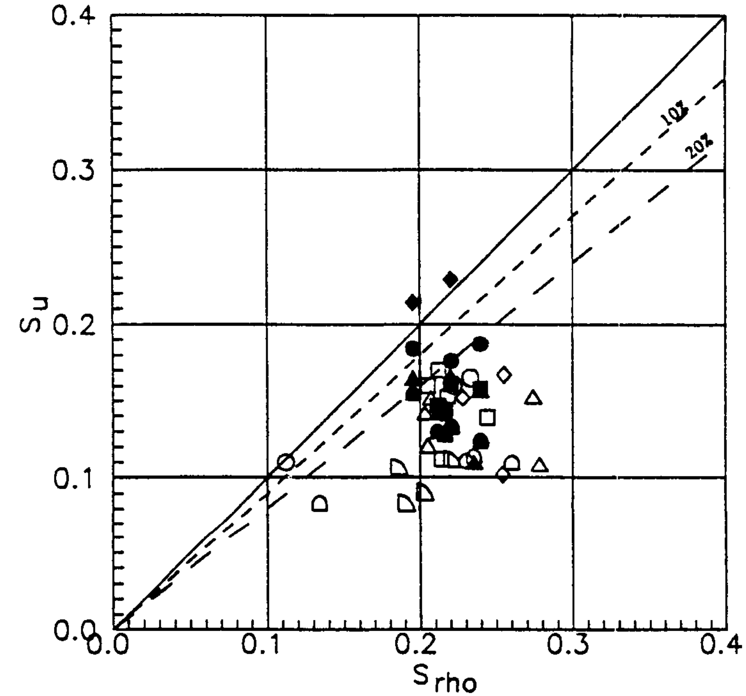

Figure 30.4 S_u vs. S_ρ, $E = f(U, \rho To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

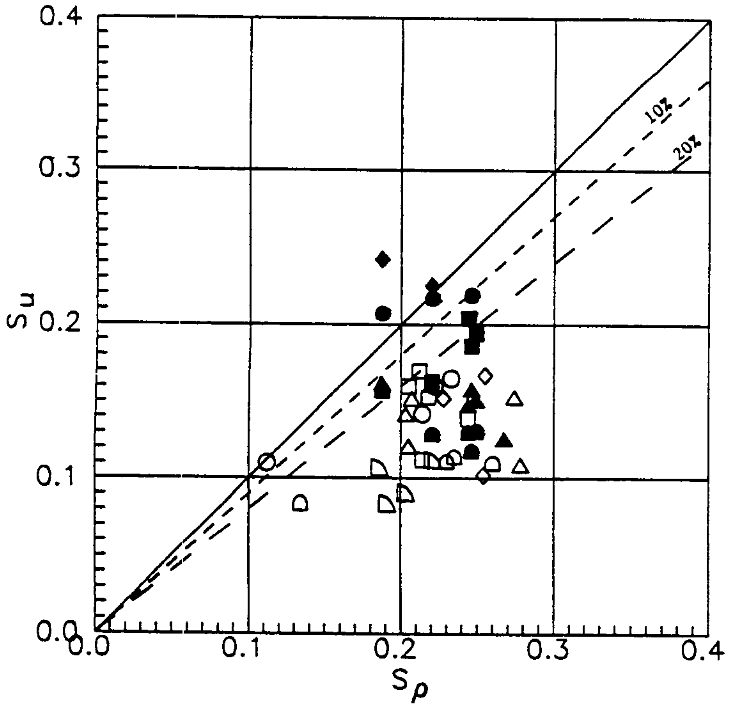

Figure 30.5 S_u vs. S_ρ, $E = f(U, \rho, To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◖	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

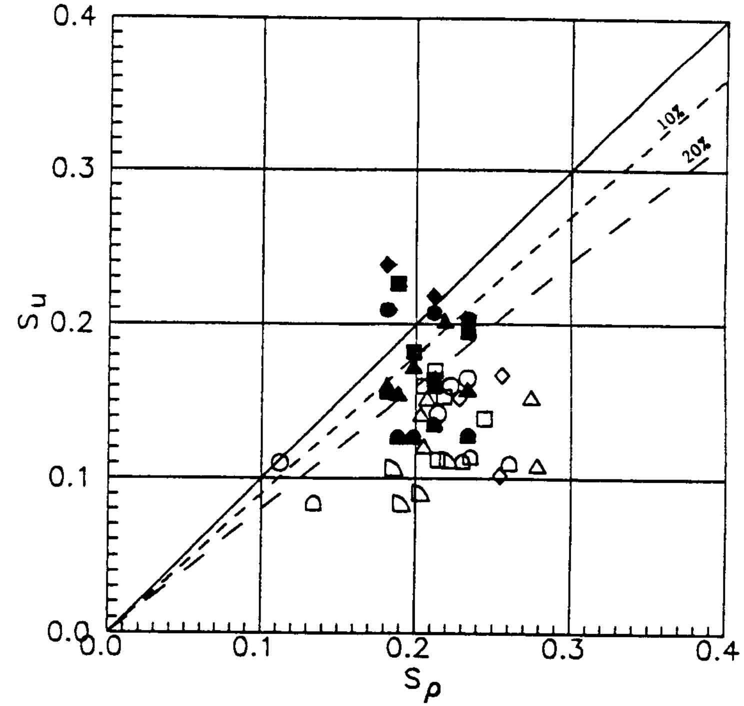

Figure 30.6 S_u vs. S_ρ, $E = f(U, \rho, To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◖	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

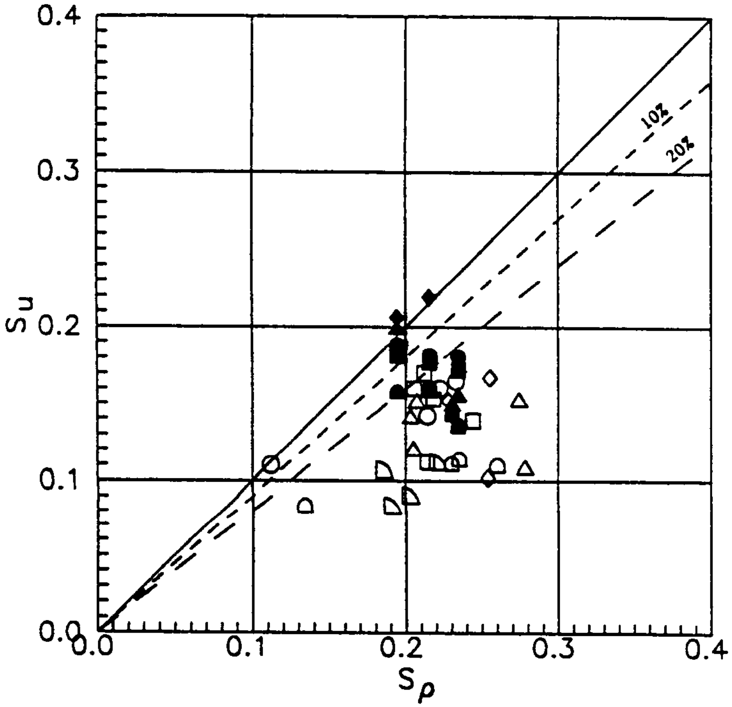

Figure 30.7 S_u vs. S_ρ, $E = f(U, \rho, To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

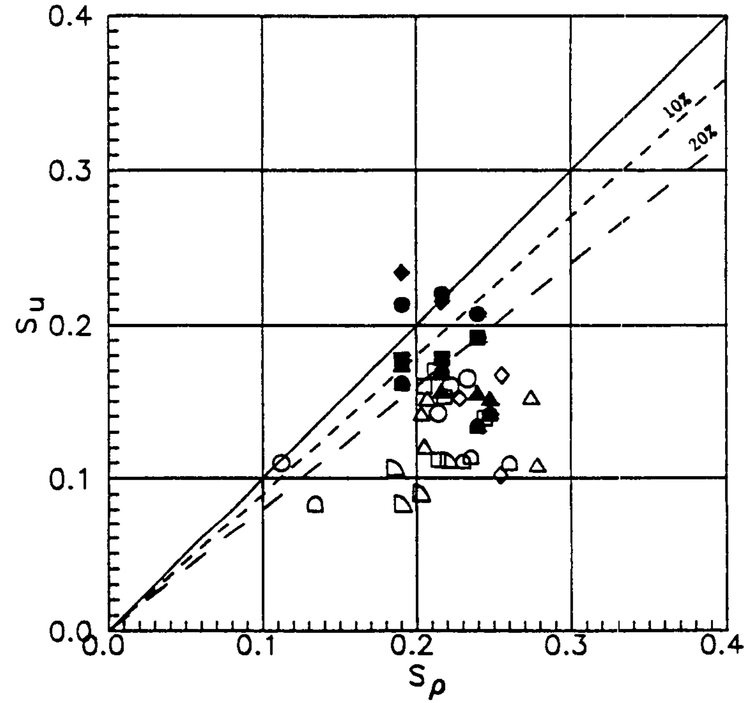

Figure 30.8 S_u vs. S_ρ, $E = f(U, \rho, To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

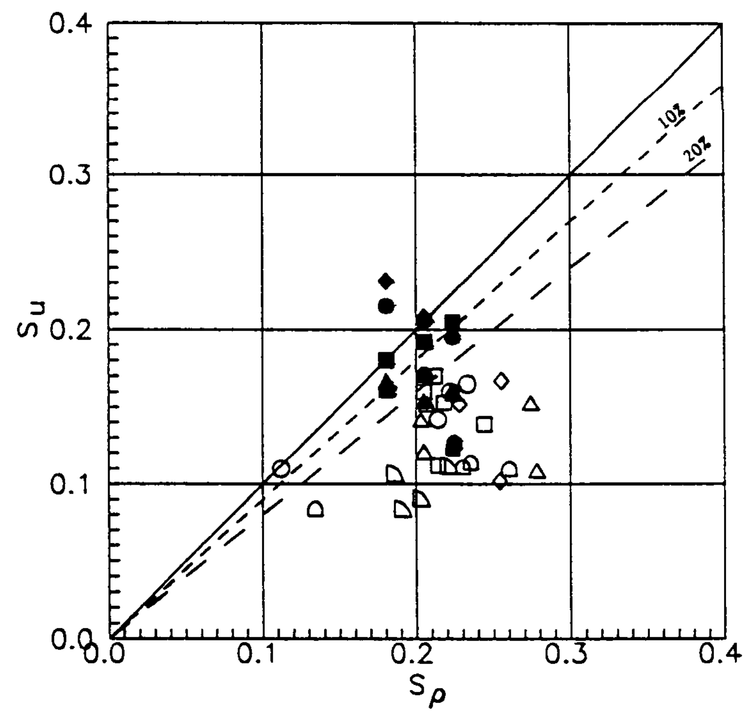

Figure 30.9 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

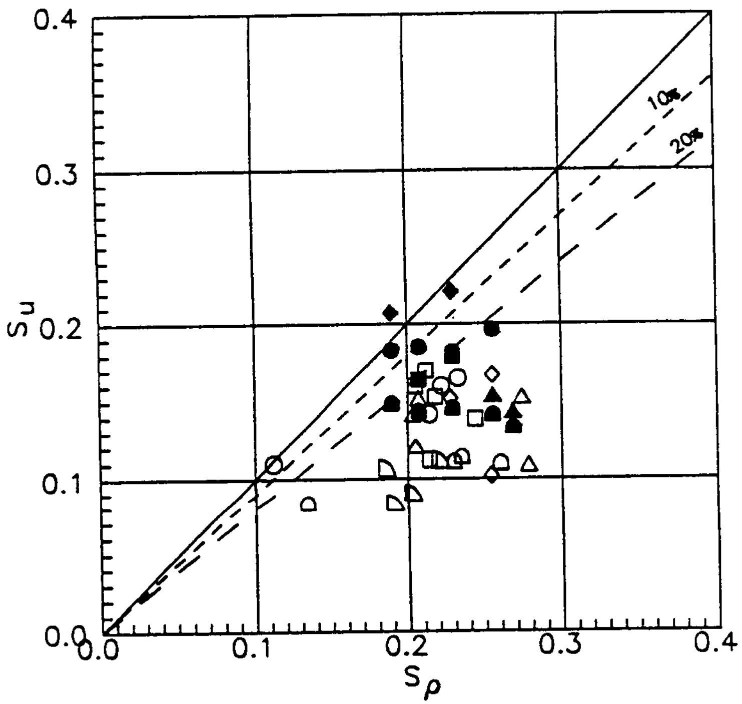

Figure 31.1 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌓	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

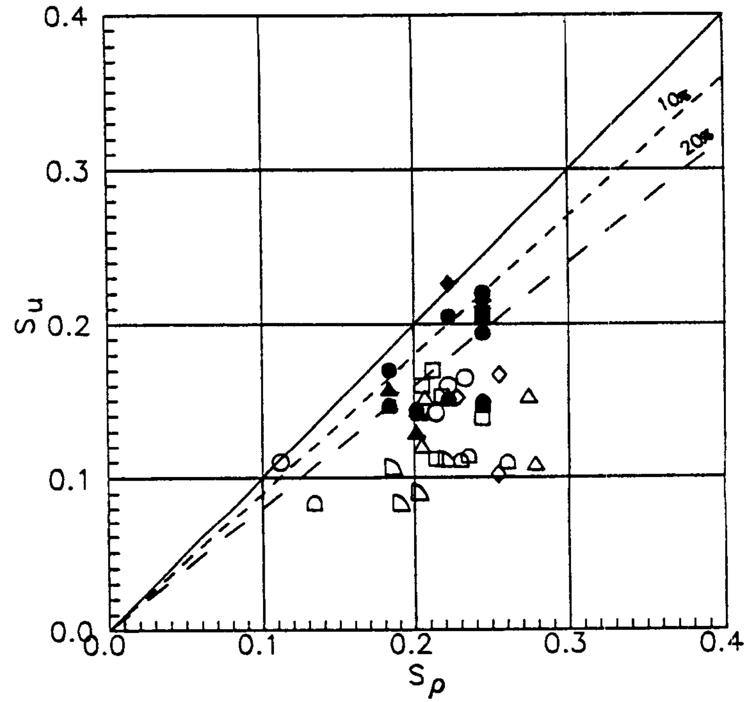

Figure 31.2 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌓	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

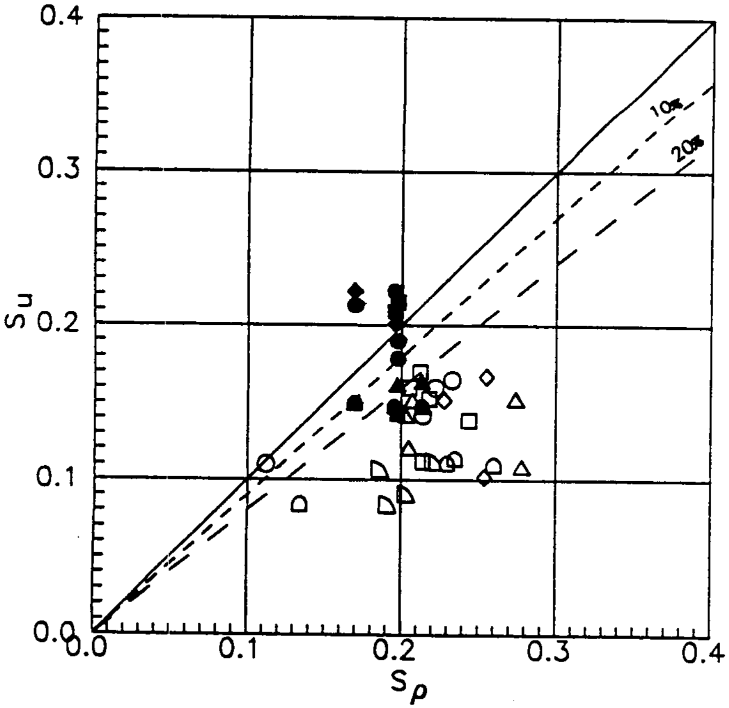

Figure 31.3 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

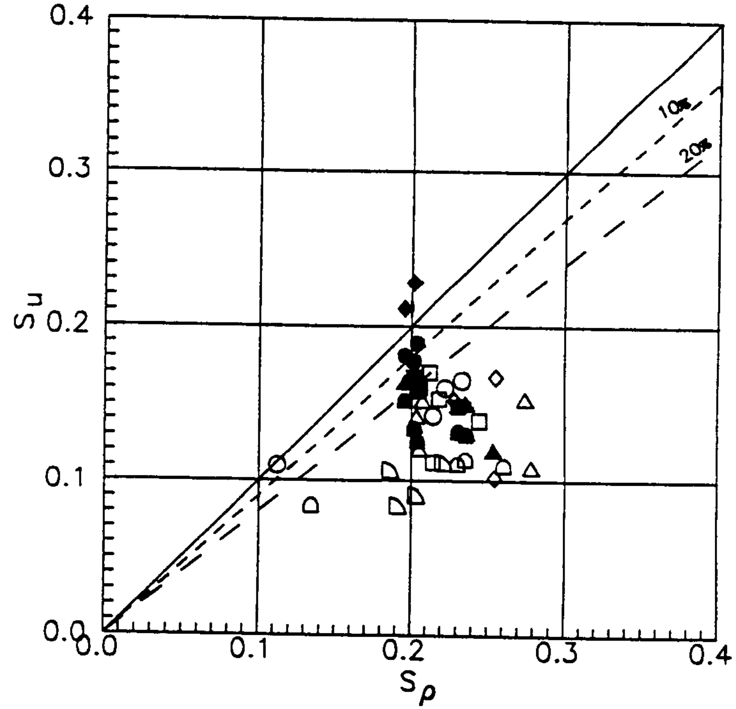

Figure 31.4 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

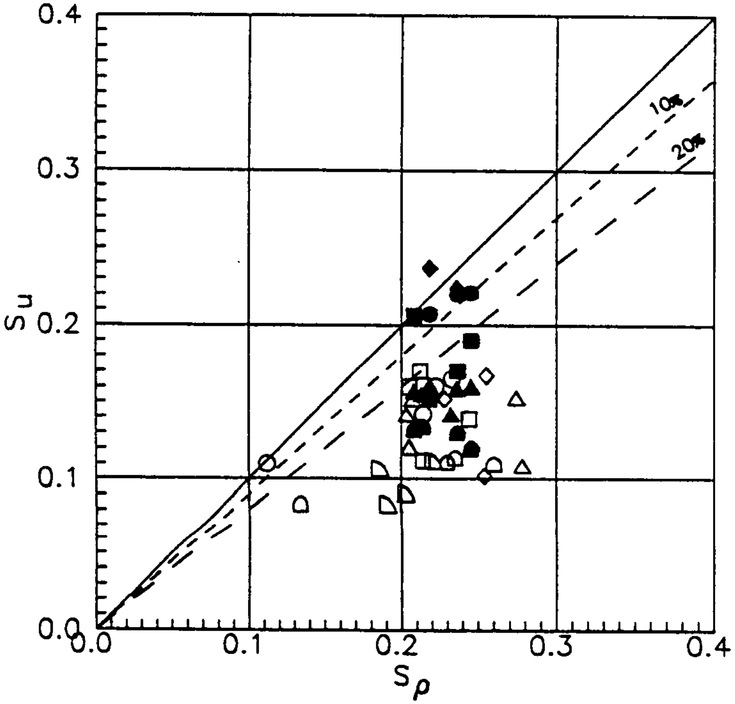

Figure 31.5 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

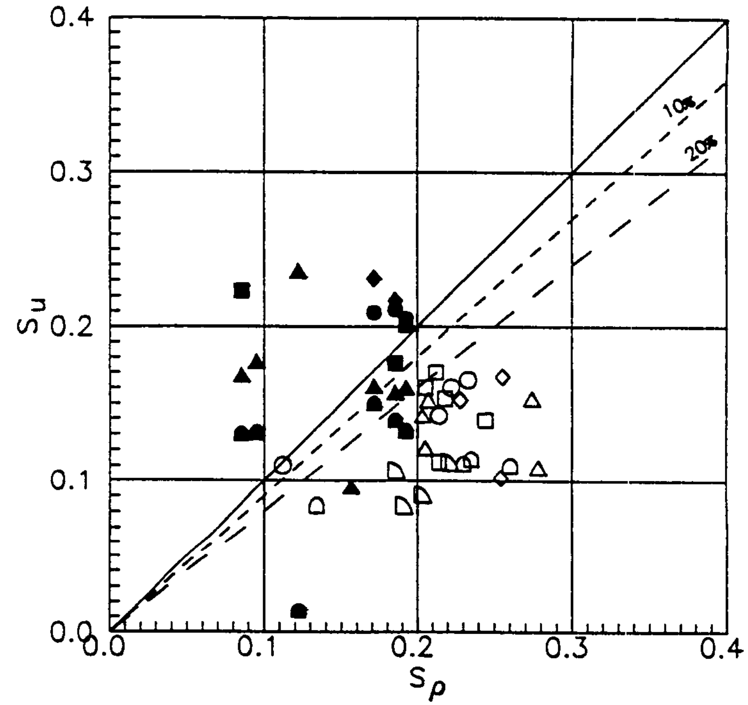

Figure 31.6 S_u vs. S_ρ, Nut = f(M,Knτ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

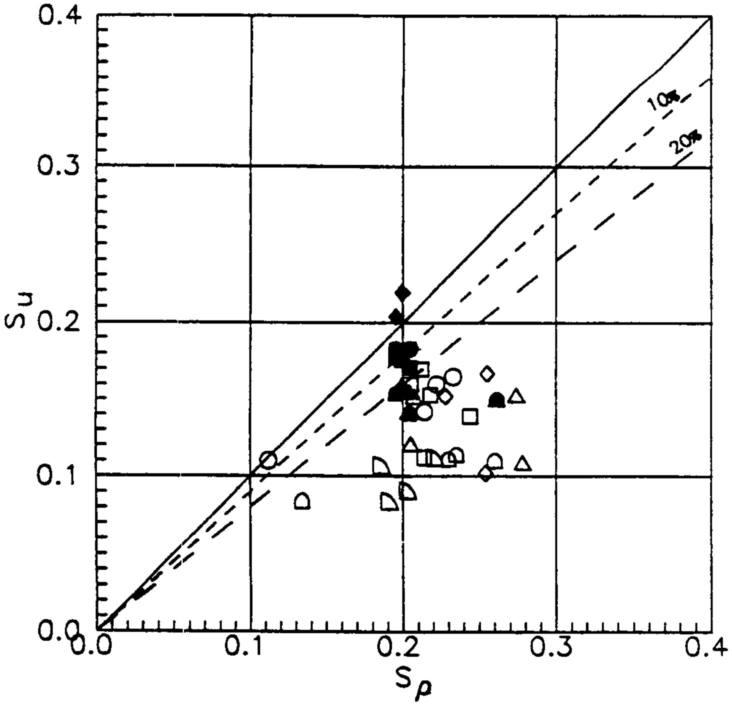

Figure 31.7 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

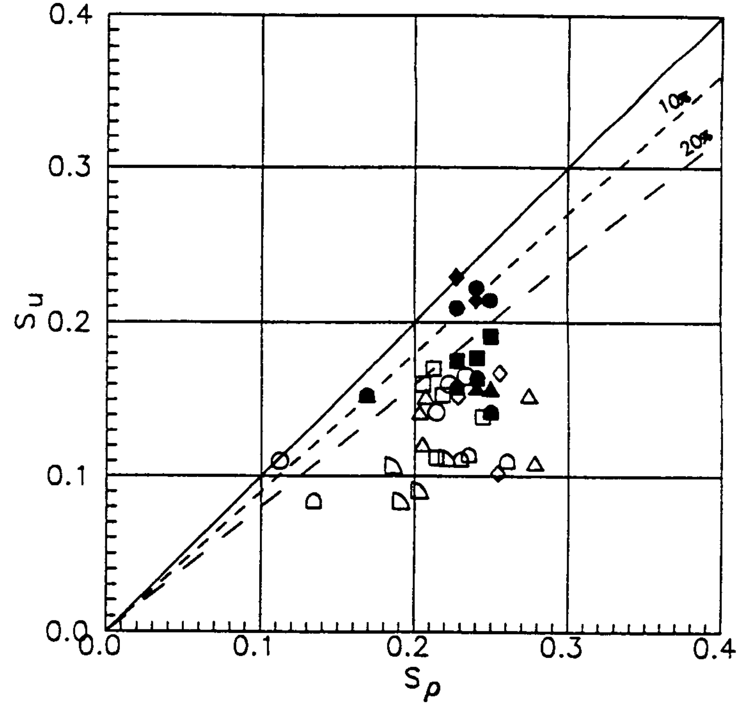

Figure 31.8 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

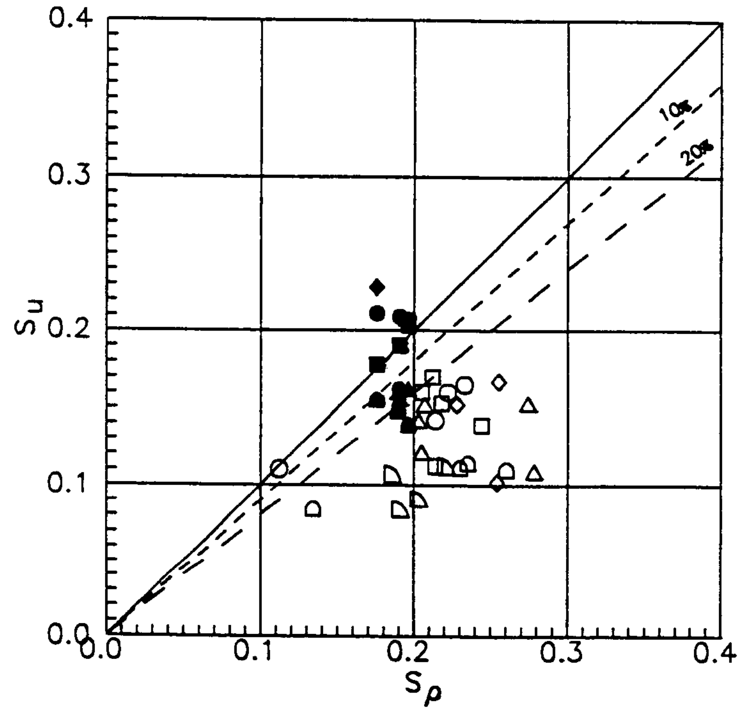

Figure 31.9 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, P–wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
☗	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	☖	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

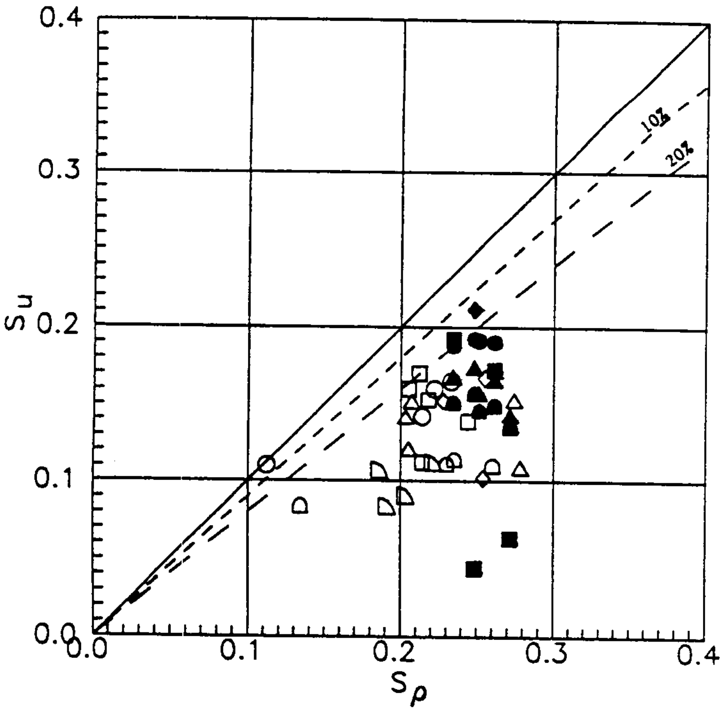

Figure 32.1 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

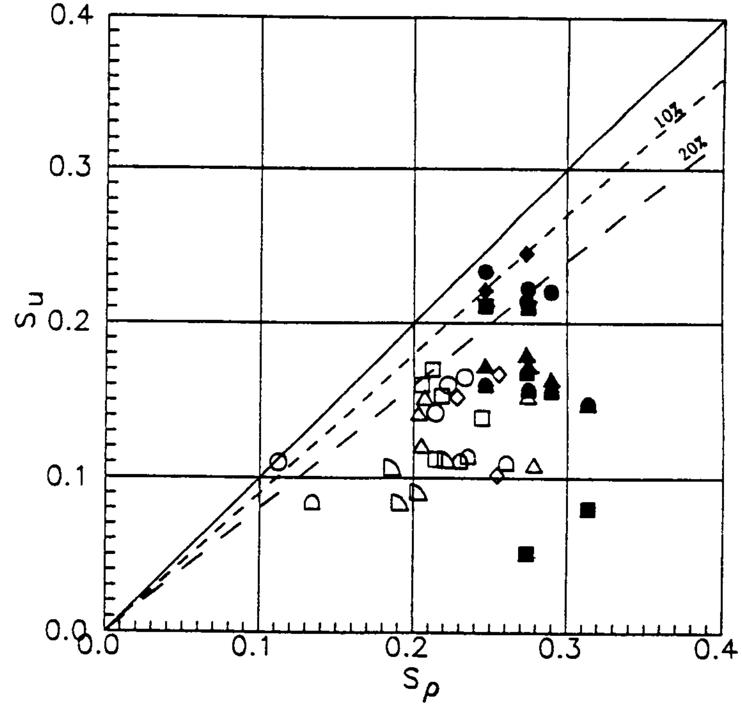

Figure 32.2 S_u vs. S_ρ, E = f(Uρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	Ω	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

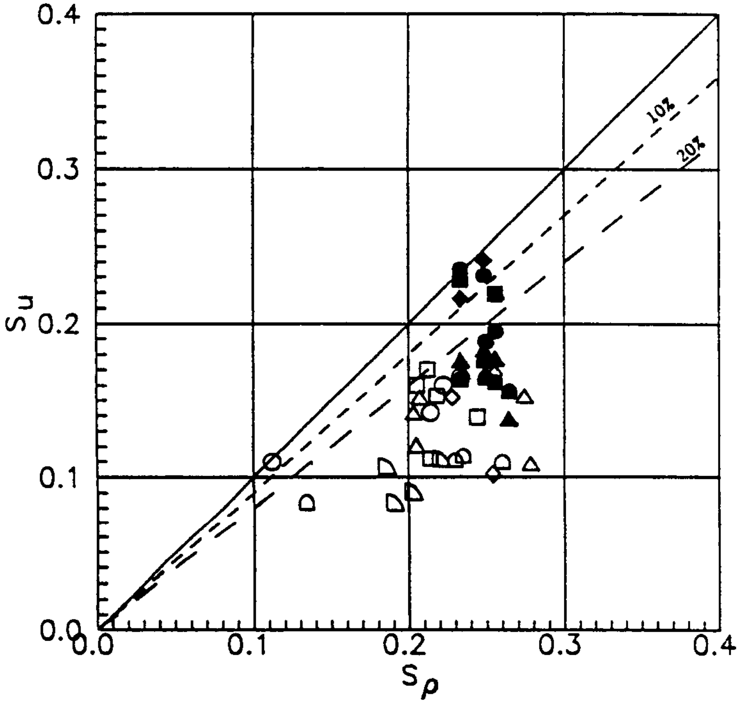

Figure 32.3 S_u vs. S_ρ, E = f(U, ρTo), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

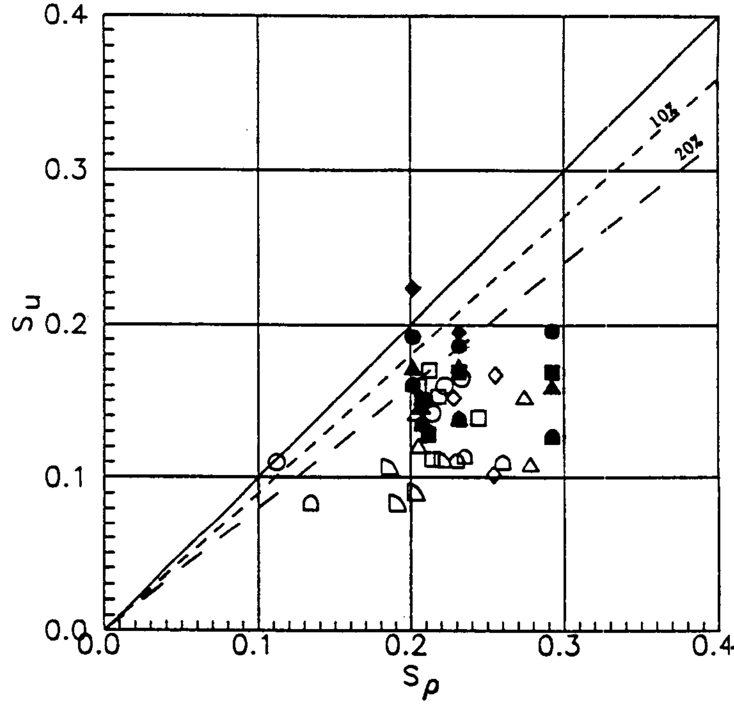

Figure 32.4 S_u vs. S_ρ, E = f(U, ρTo), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

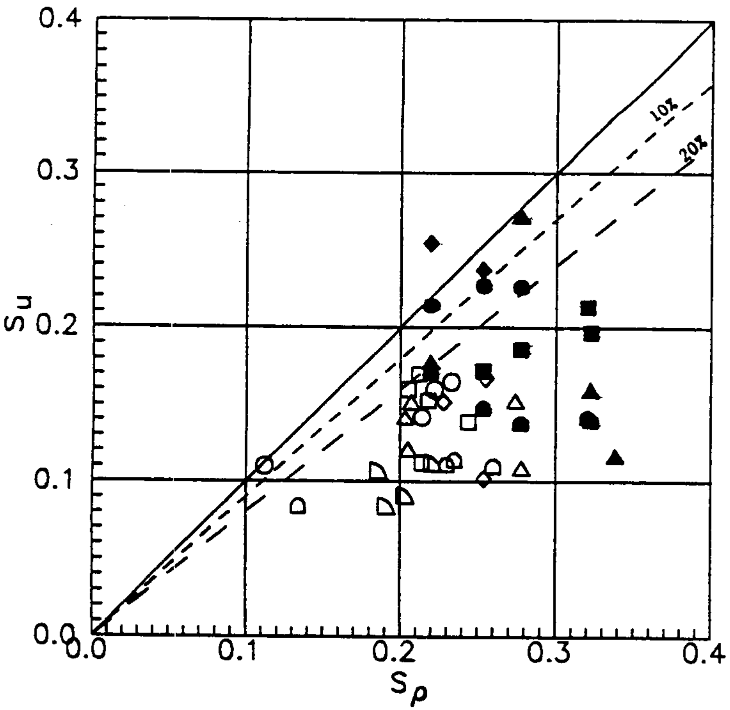

Figure 32.5 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

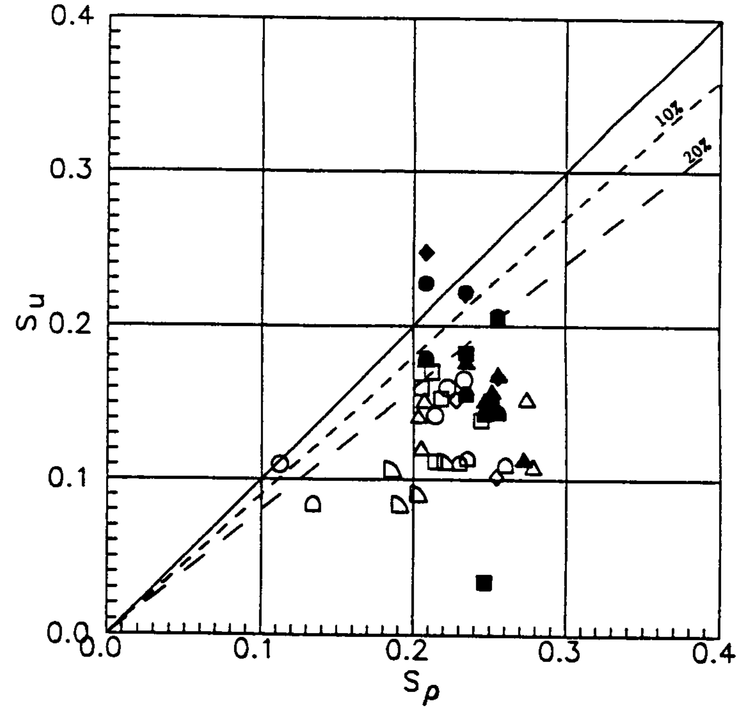

Figure 32.6 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

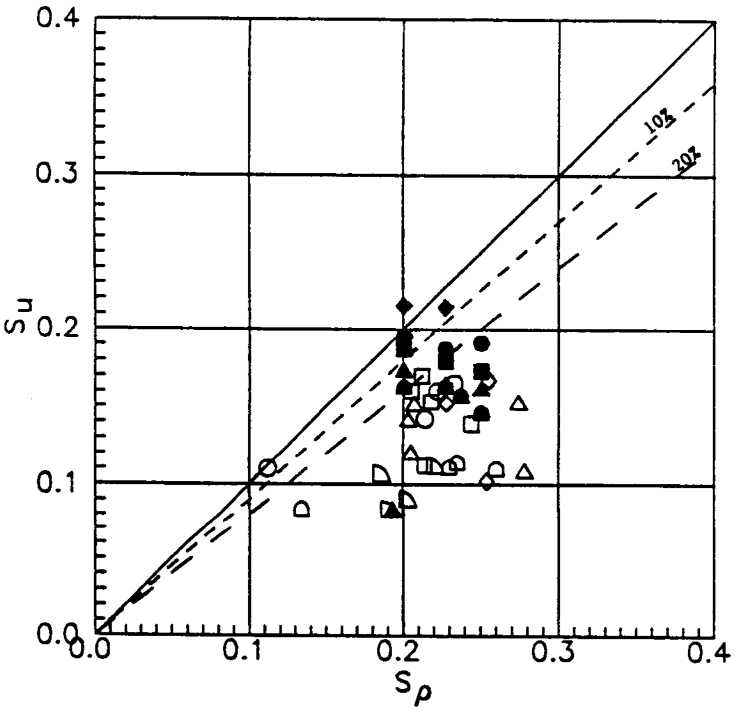

Figure 32.7 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
▲	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	▢	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

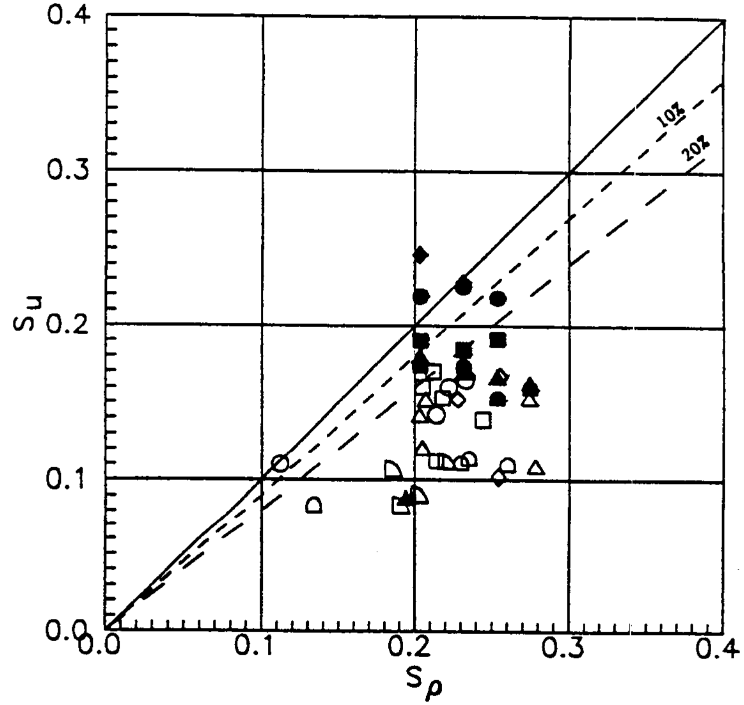

Figure 32.8 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
▲	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	▢	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

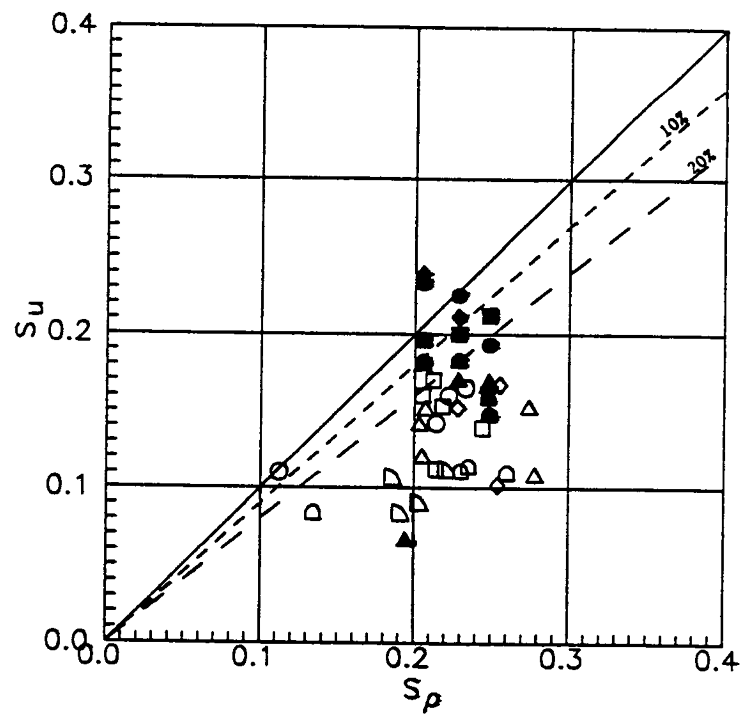

Figure 32.9 S_u vs. S_ρ, E = f(U, ρ, To), local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, Y–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
⬟	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◘	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

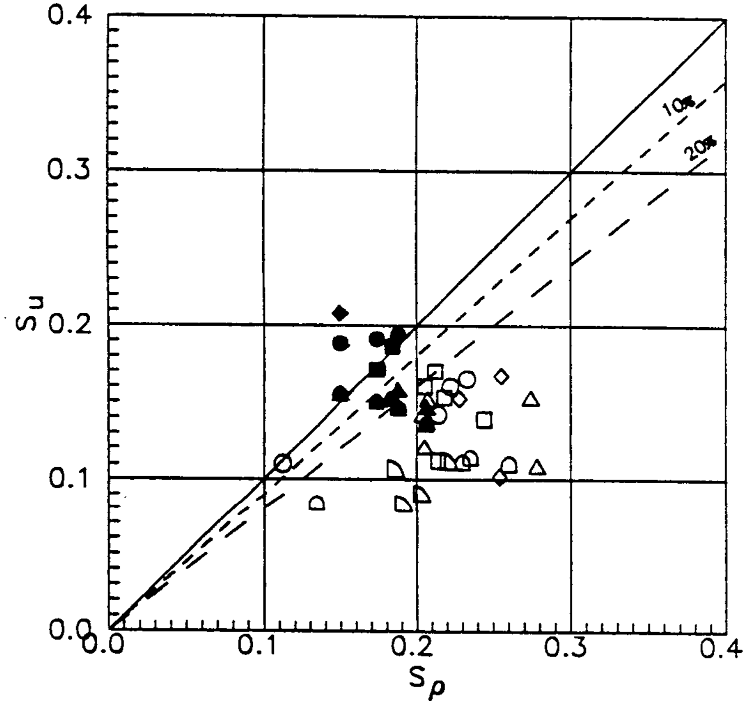

Figure 33.1 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

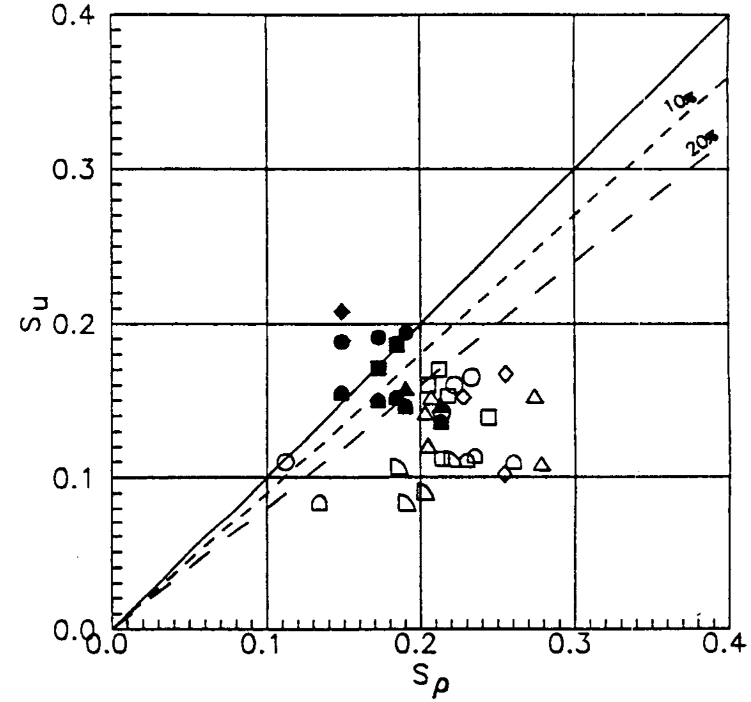

Figure 33.2 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

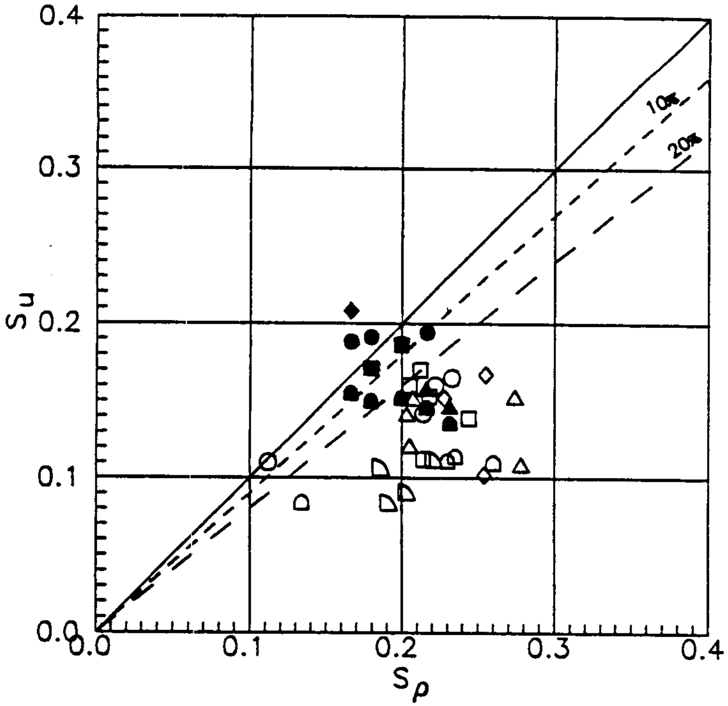

Figure 33.3 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

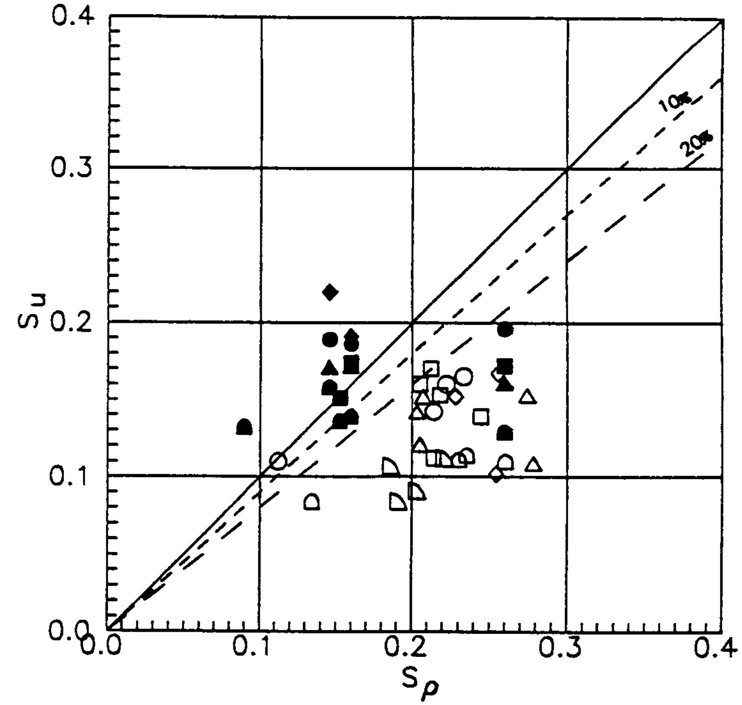

Figure 33.4 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

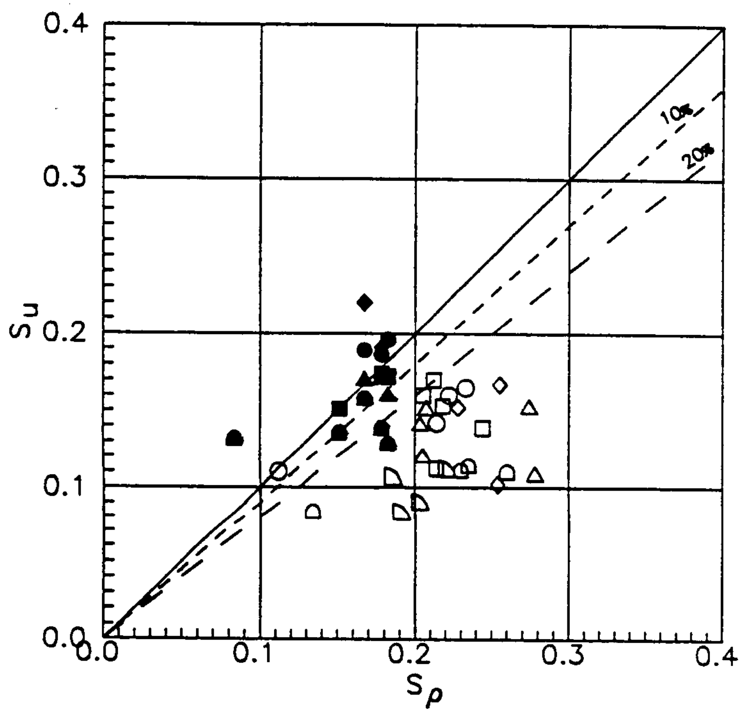

Figure 33.5 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◻	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

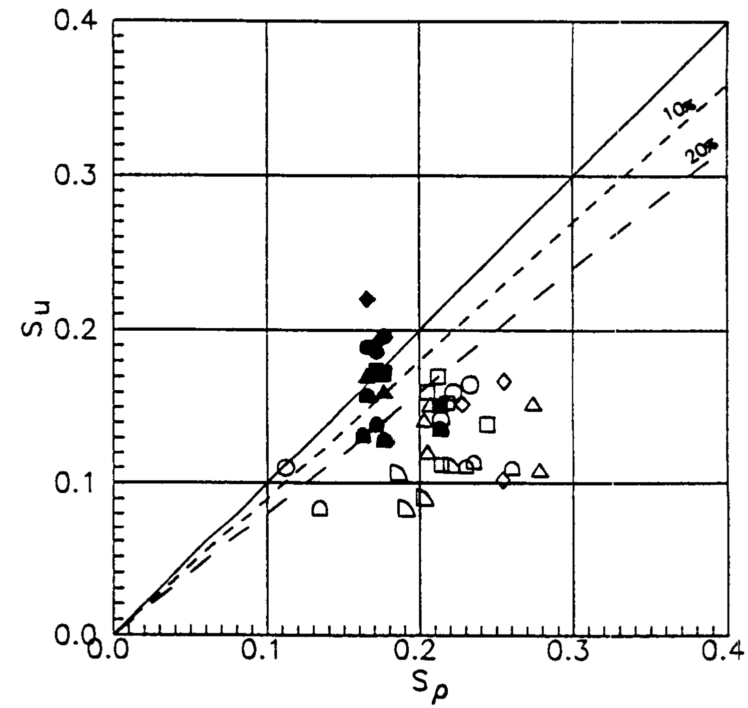

Figure 33.6 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, Y–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◻	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

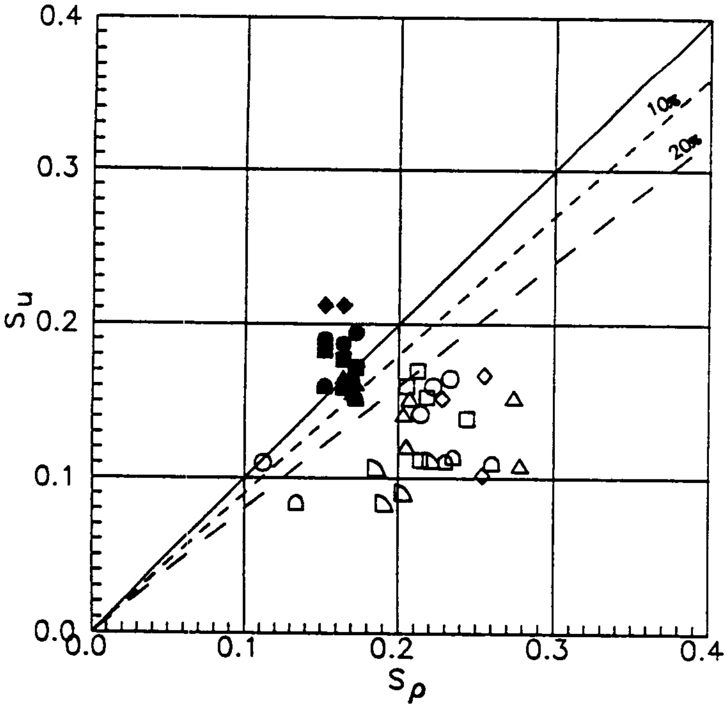

Figure 33.7 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, Y–wire, To = 120 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌓	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

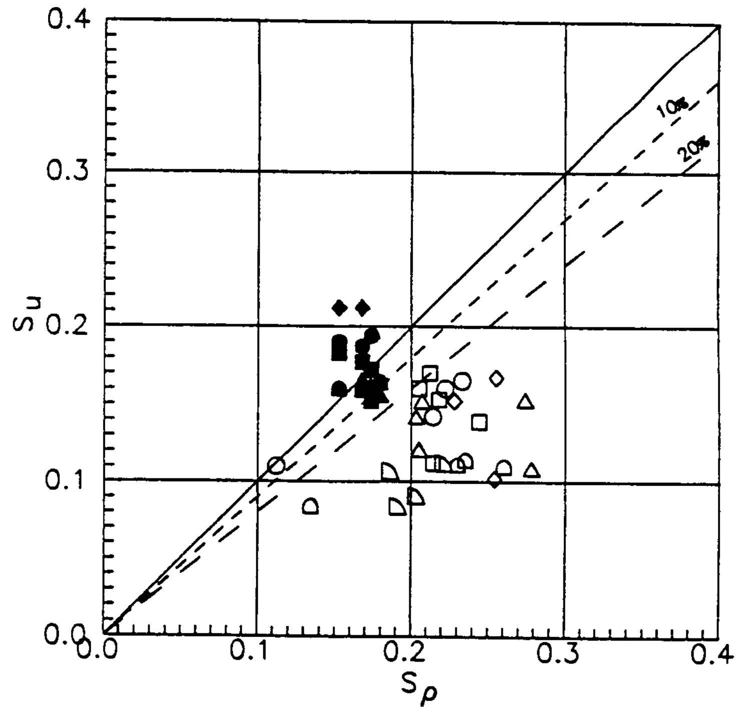

Figure 33.8 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00032 inch, Y–wire, To = 120 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	⌓	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

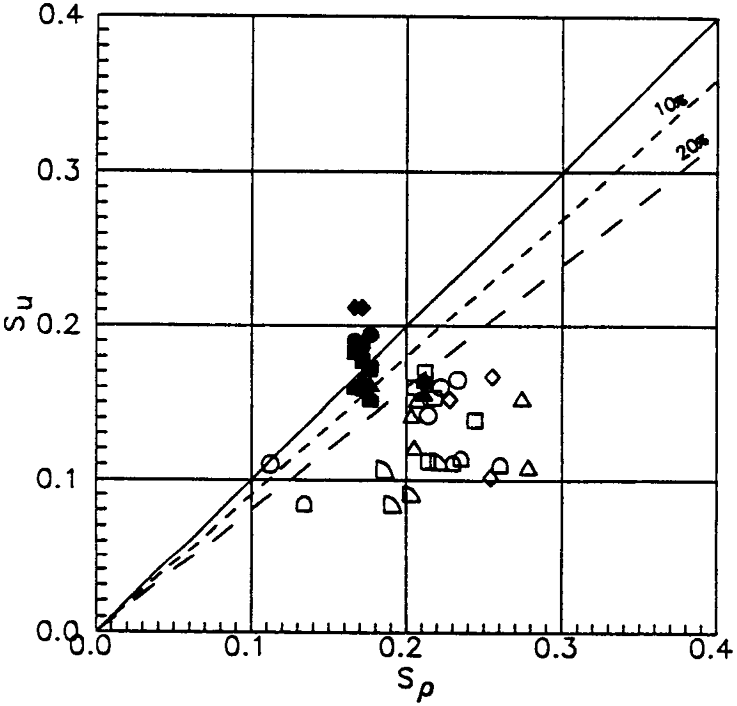

Figure 33.9 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00050 inch, Y–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
⬢	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

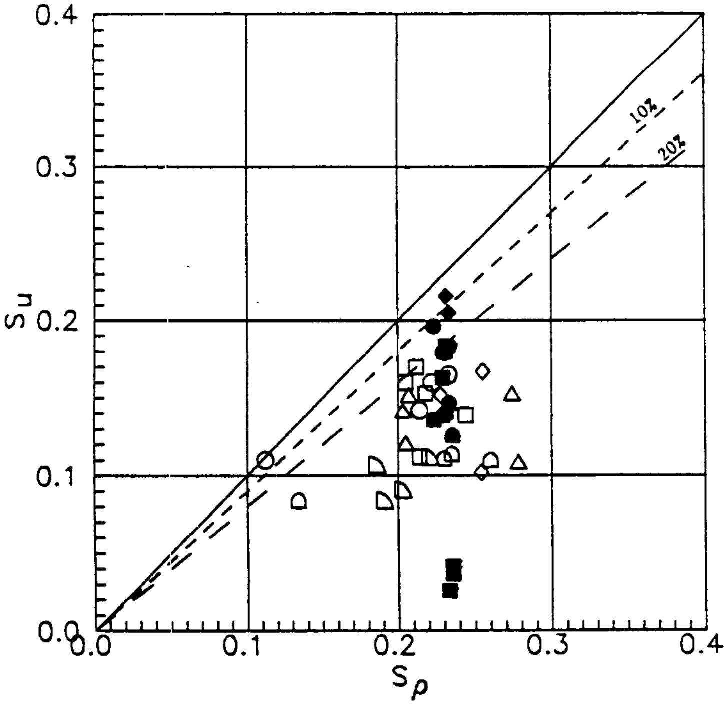

Figure 34.1 S_u vs. S_ρ, $E = f(U, \rho, To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S-wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◒	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

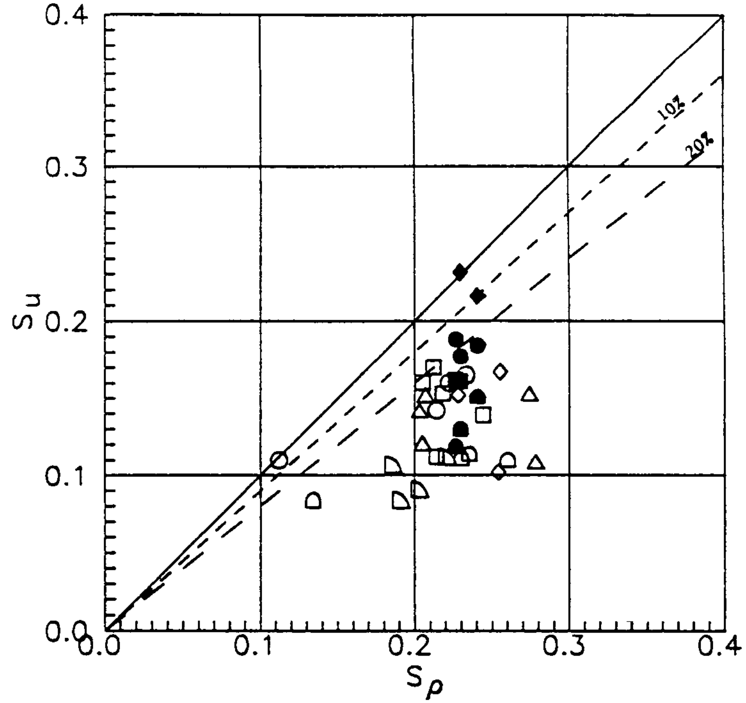

Figure 34.2 S_u vs. S_ρ, $E = f(U, \rho, To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S-wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◒	0.037	◗	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

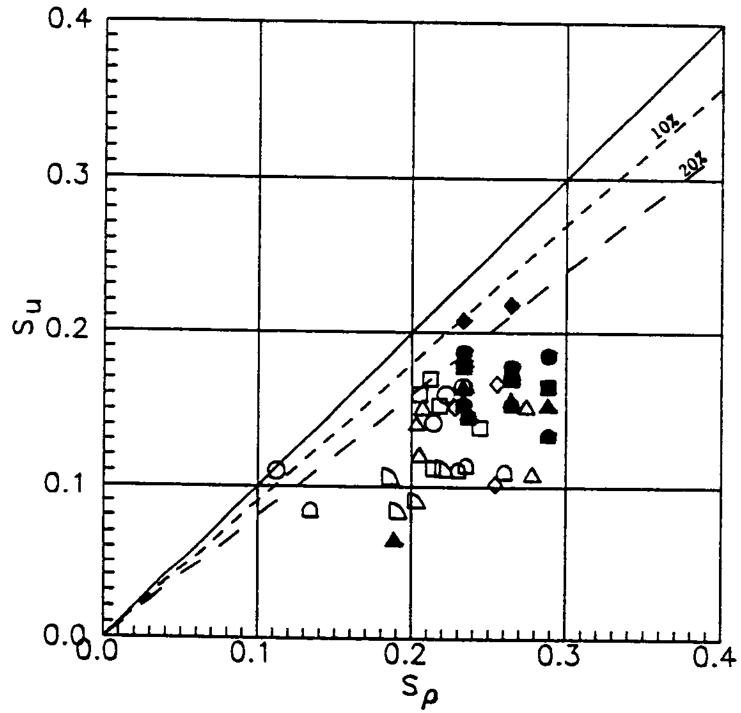

Figure 34.3 S_u vs. S_ρ, $E = f(U, \rho, To)$, local fit
(E vs. ρ, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
⬟	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

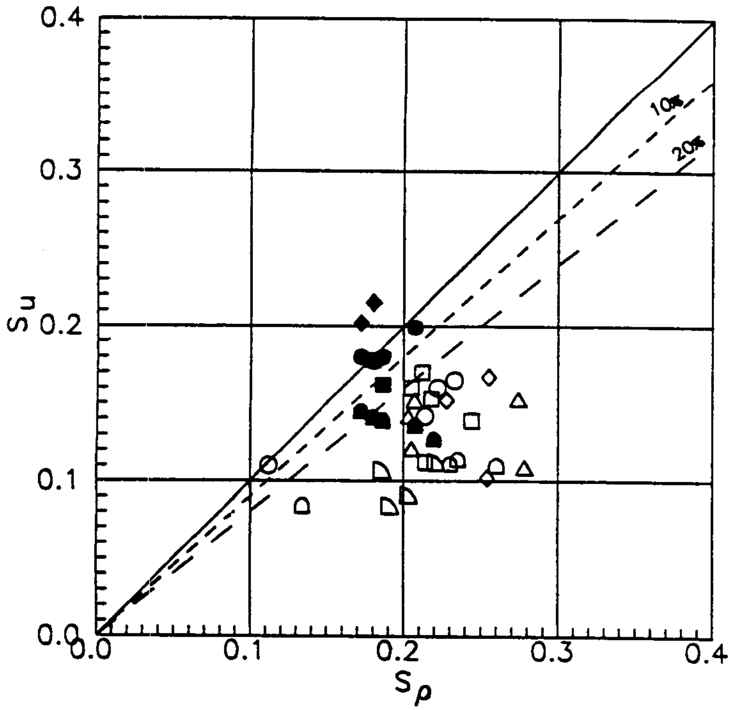

Figure 35.1 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

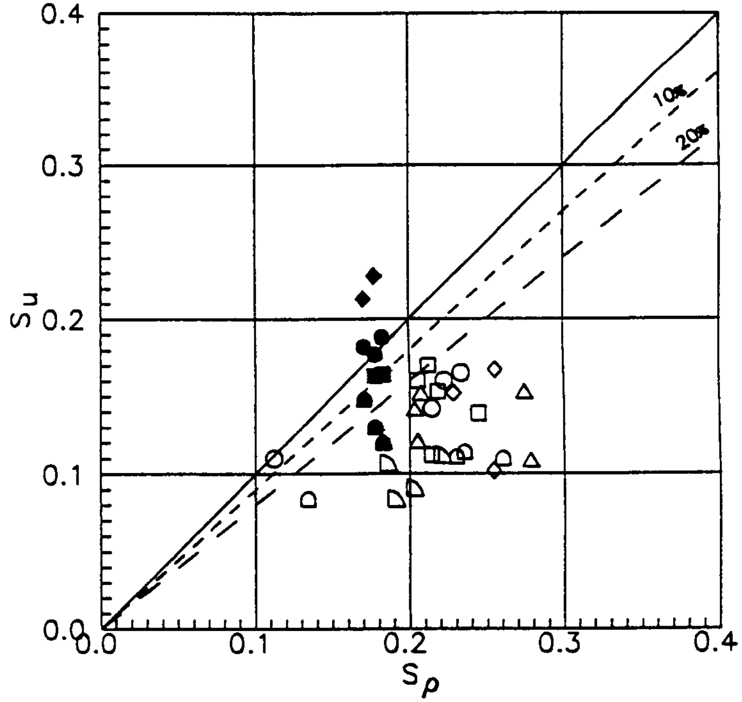

Figure 35.2 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

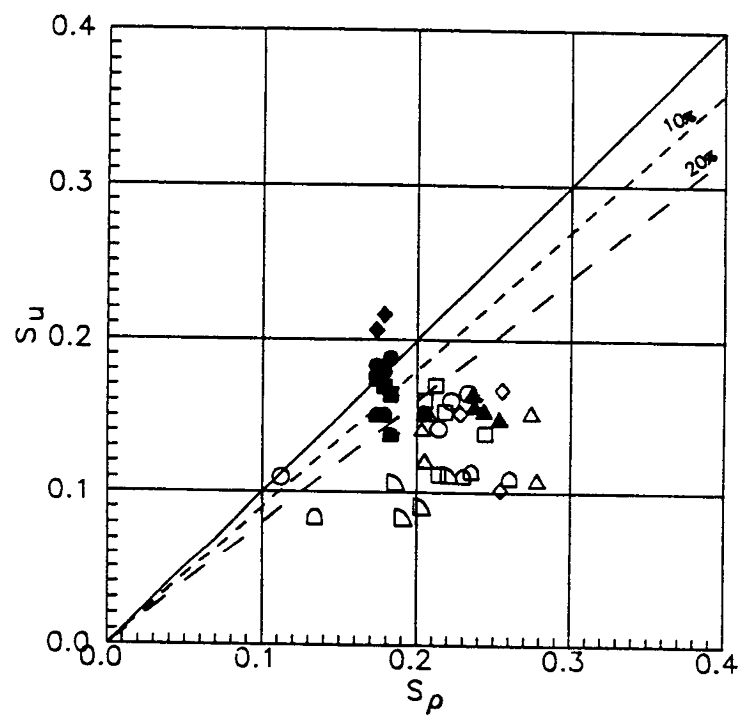

Figure 35.3 S_u vs. S_ρ, Nut = f(M,Kn,τ), local fit
(Nut vs. Kn, Linear fit in log–log space for S_ρ)
dw = 0.00015 inch, S–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	○	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

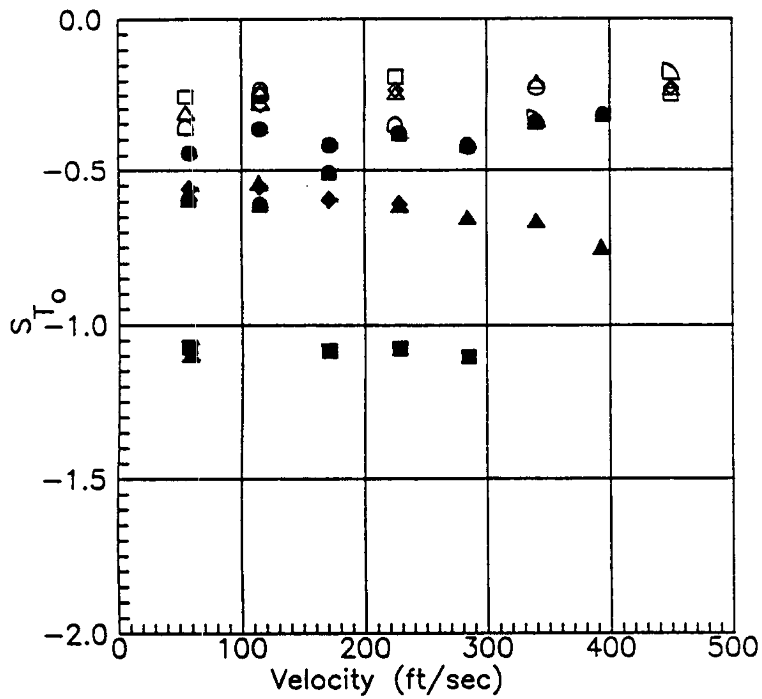

Figure 36.1 Velocity vs. S_{To}, E = f(U,ρ,To), local fit
dw = 0.00015 inch, P–wire, To = 80
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

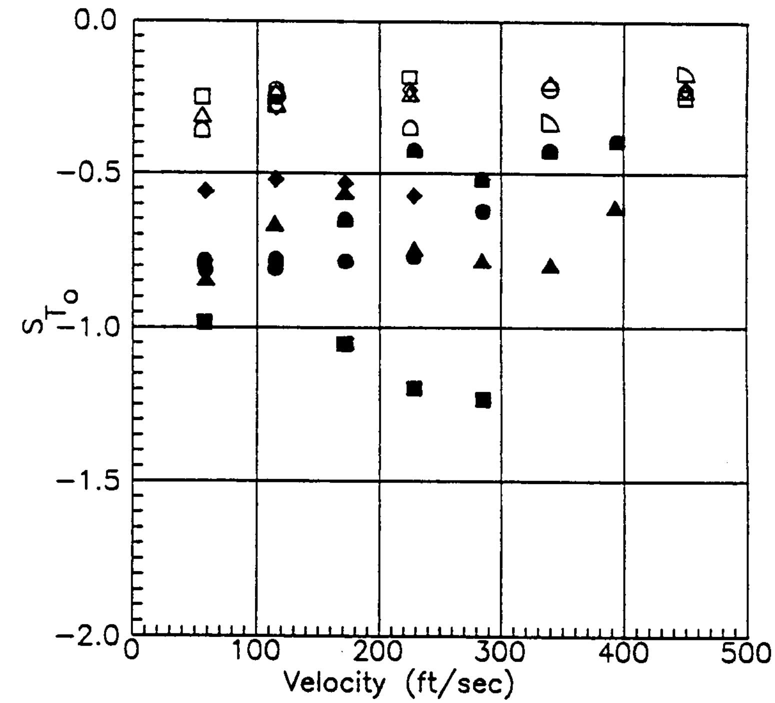

Figure 36.2 Velocity vs. S_{To}, E = f(U,ρ,To), local fit
dw = 0.00032 inch, P–wire, To = 80
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

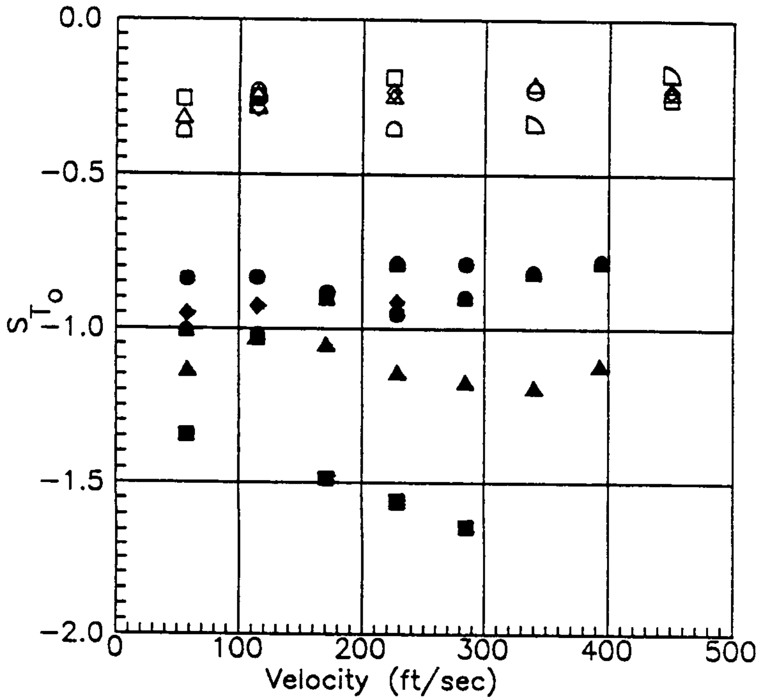

Figure 36.3 Velocity vs. S_{To}, $E = f(U,\rho,To)$, local fit
dw = 0.00050 inch, P–wire, To = 80
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◁	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

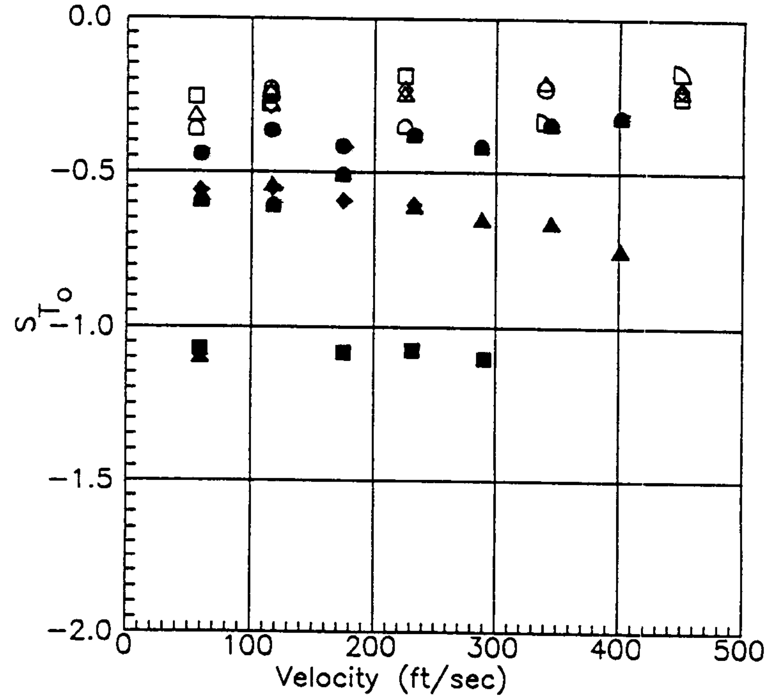

Figure 36.4 Velocity vs. S_{To}, $E = f(U,\rho,To)$, local fit
dw = 0.00015 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◁	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

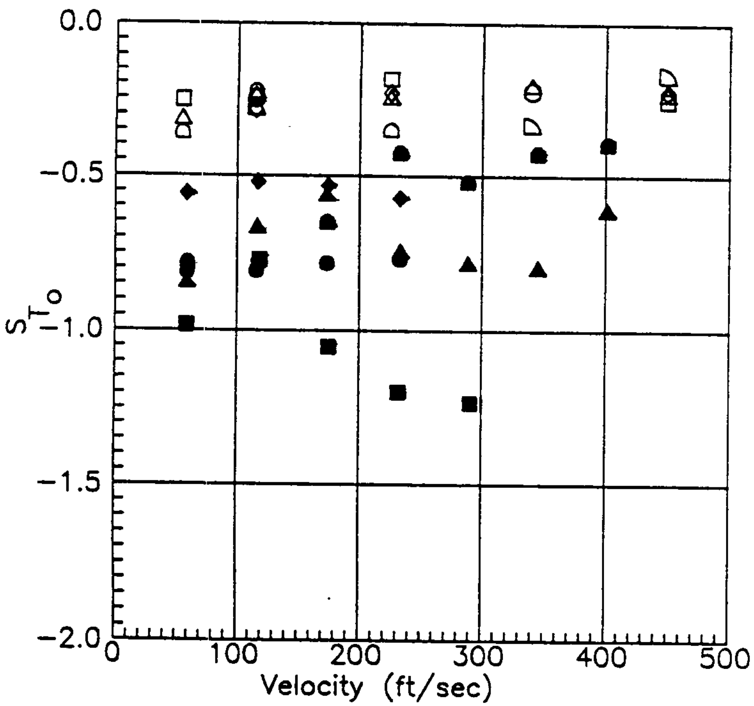

Figure 36.5 Velocity vs. S_{To}, E = f(U,ρ,To), local fit
dw = 0.00032 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

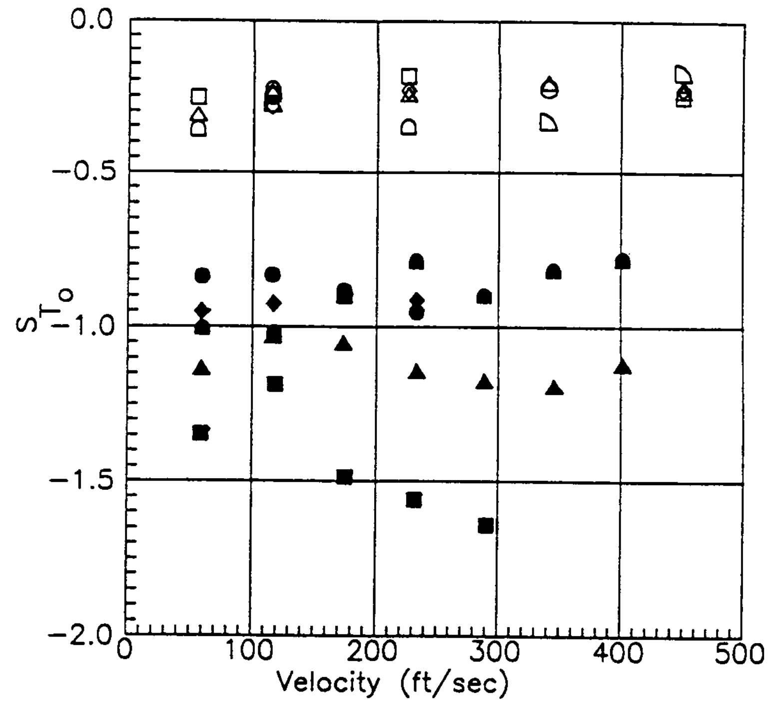

Figure 36.6 Velocity vs. S_{To}, E = f(U,ρ,To), local fit
dw = 0.00050 inch, P–wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

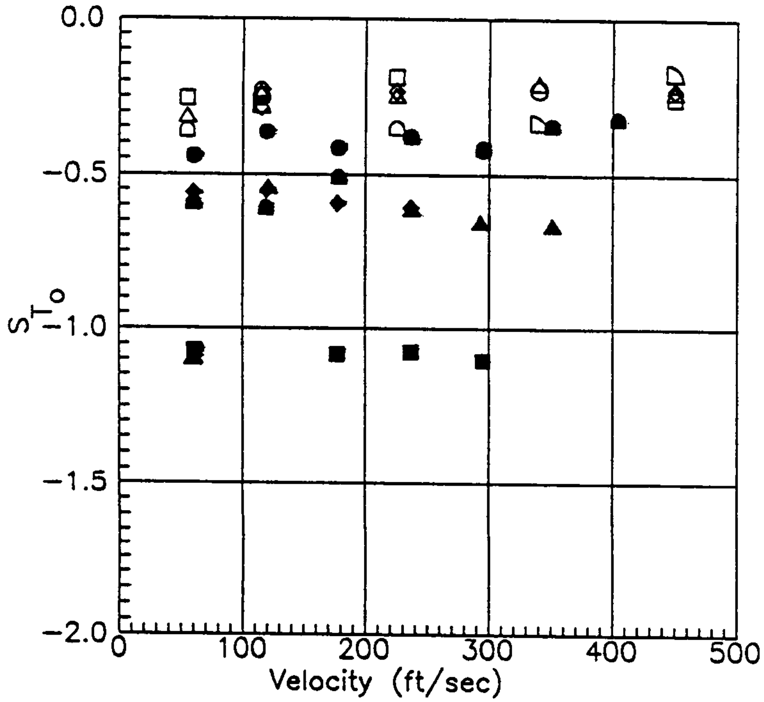

Figure 36.7 Velocity vs. S_{To}, E = f(U,ρ,To), local fit
dw = 0.00015 inch, P−wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft³	Baldwin	Density,#/ft³
●	0.037	◻	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

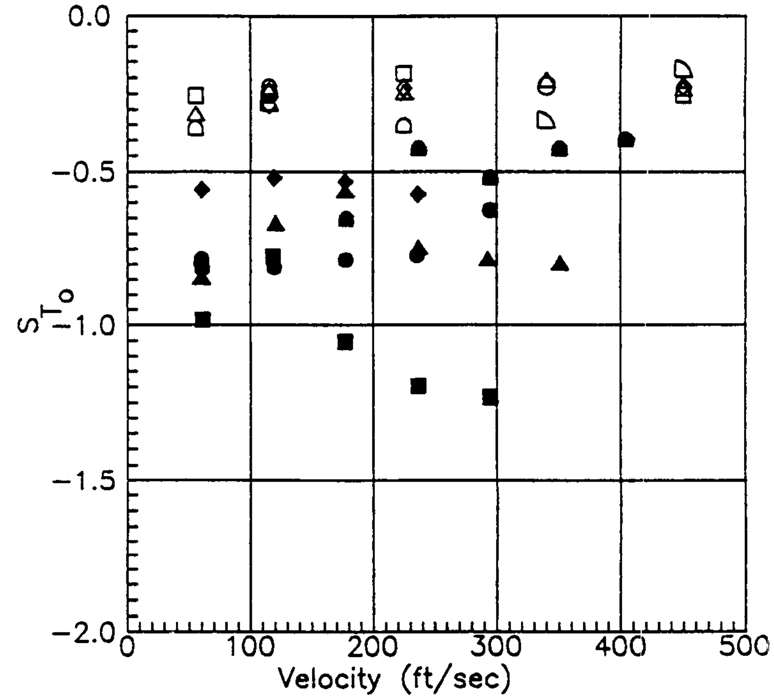

Figure 36.8 Velocity vs. S_{To}, E = f(U,ρ,To), local fit
dw = 0.00032 inch, P−wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft³	Baldwin	Density,#/ft³
●	0.037	◻	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

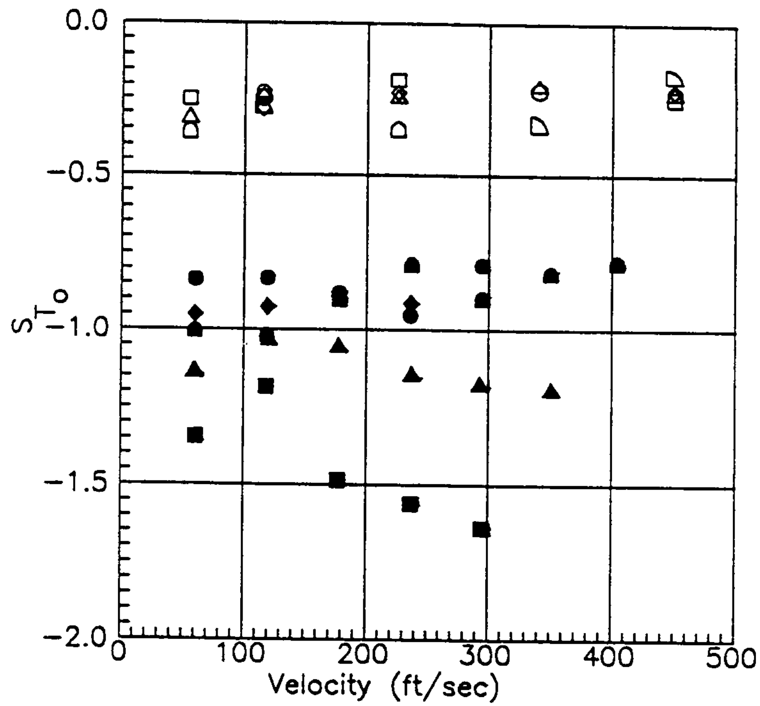

Figure 36.9 Velocity vs. S_{To}, $E = f(U, \rho, To)$, local fit
dw = 0.00050 inch, P−wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

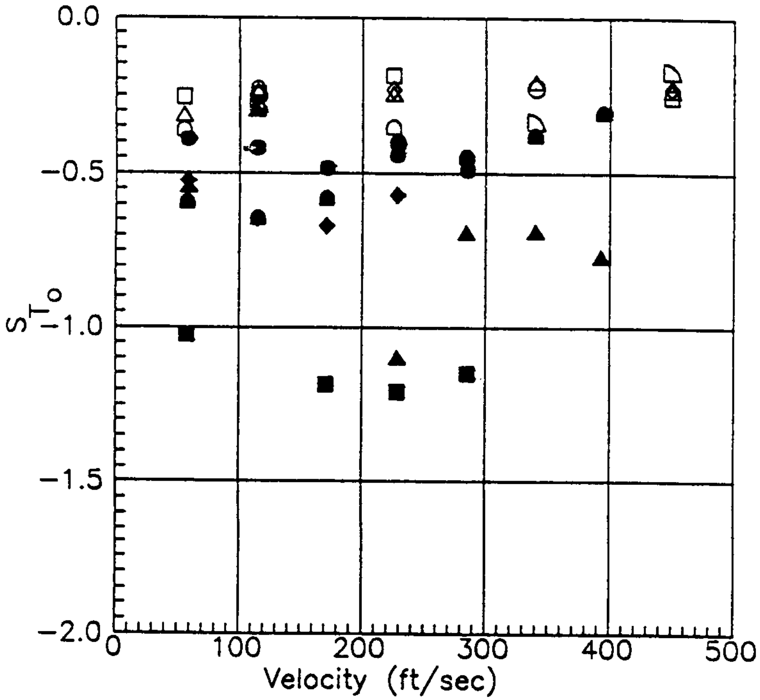

Figure 37.1 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
◓	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	∩	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

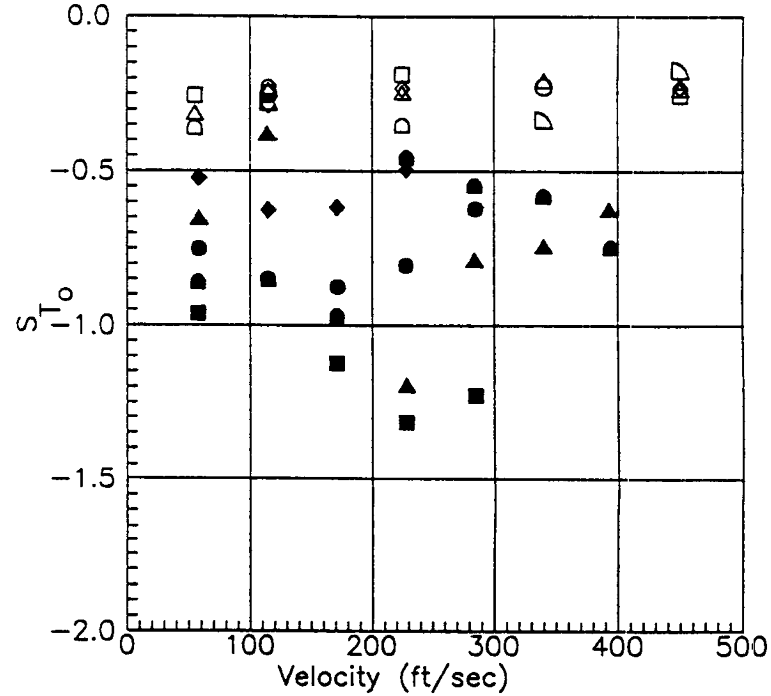

Figure 37.2 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, P–wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
◓	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	∩	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

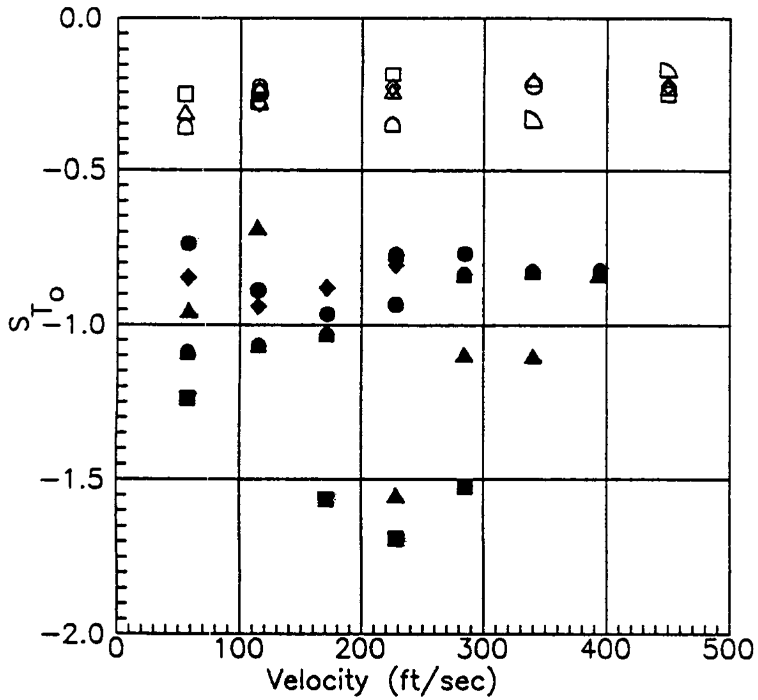

Figure 37.3 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, P-wire, To = 80 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	○	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

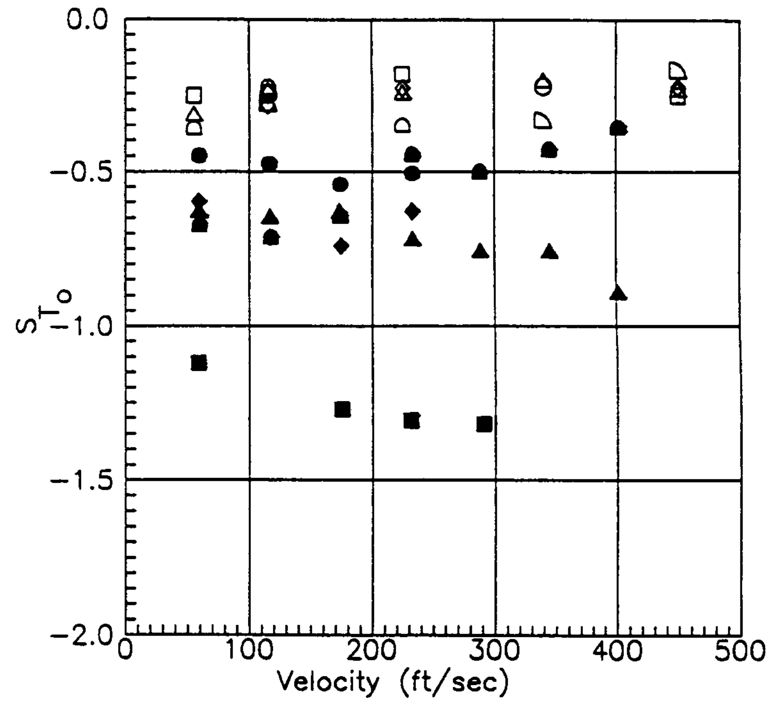

Figure 37.4 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, P-wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	○	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

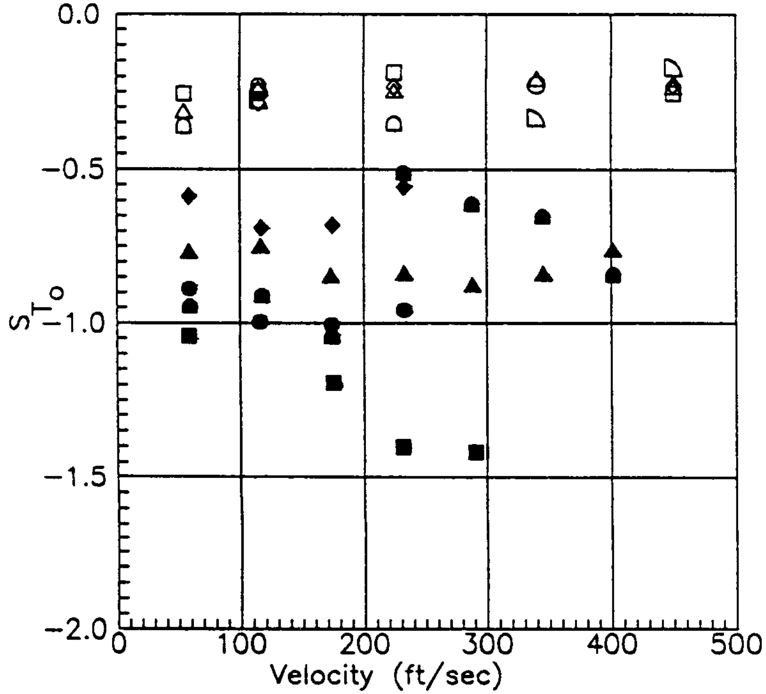

Figure 37.5 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, P−wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

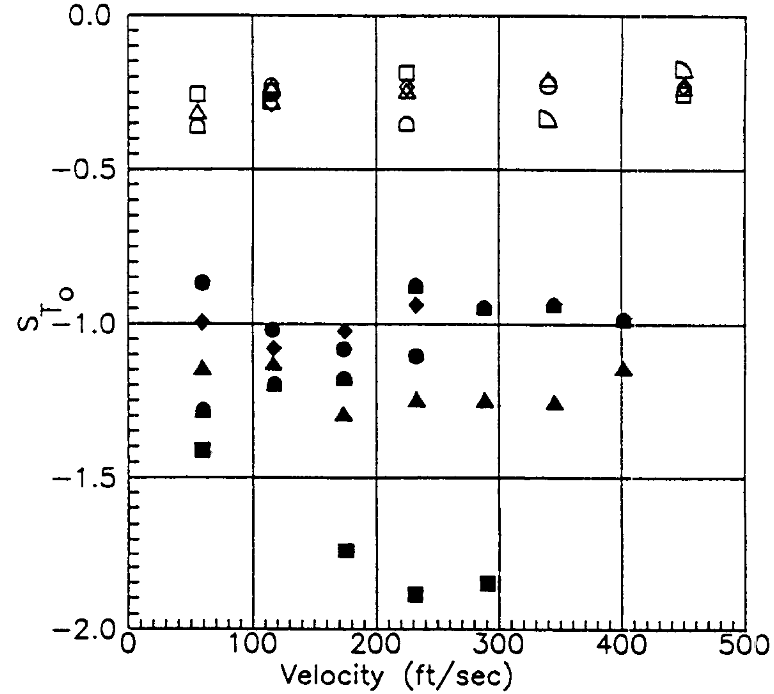

Figure 37.6 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, P−wire, To = 100 F
(Data corrected due to impedance)

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

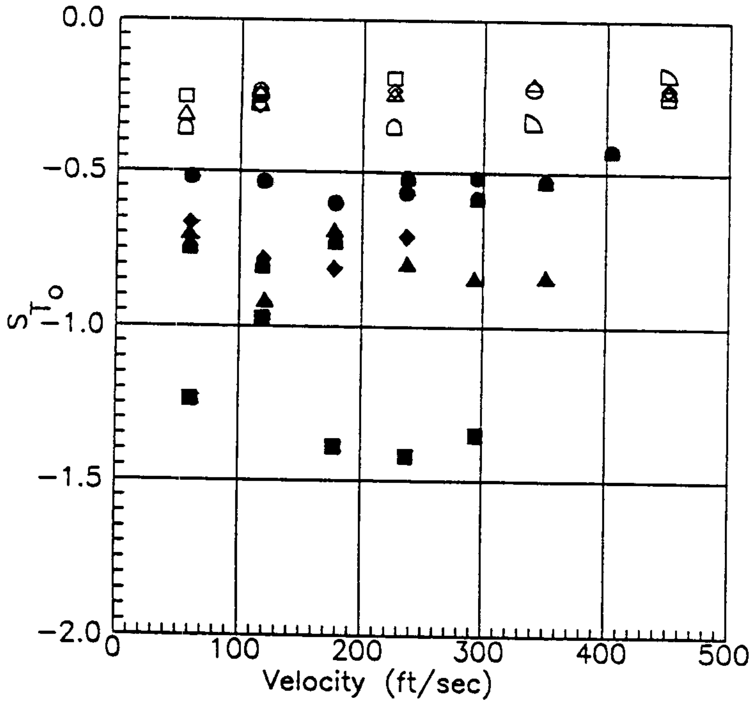

Figure 37.7 Velocity vs. S_{T_o}, Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, P-wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◿	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

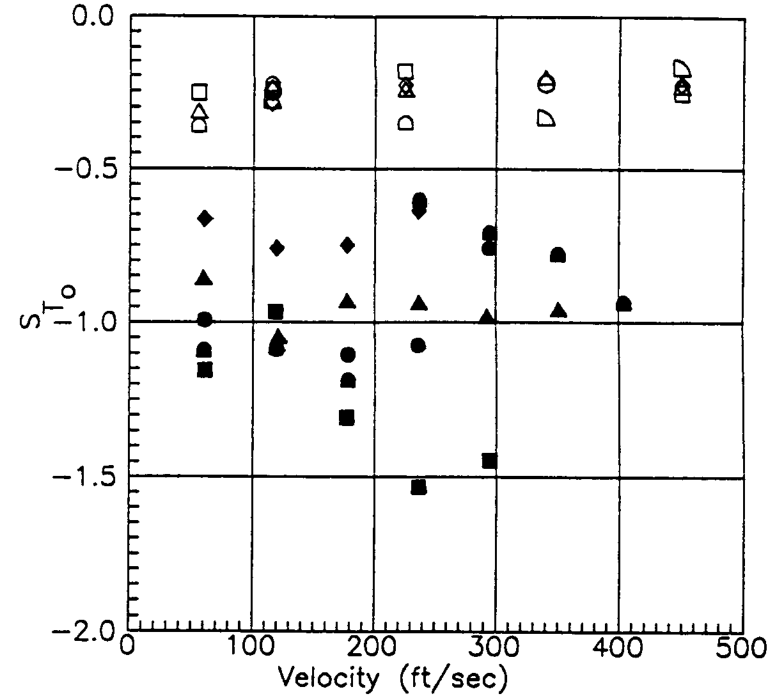

Figure 37.8 Velocity vs. S_{T_o}, Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, P-wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◿	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

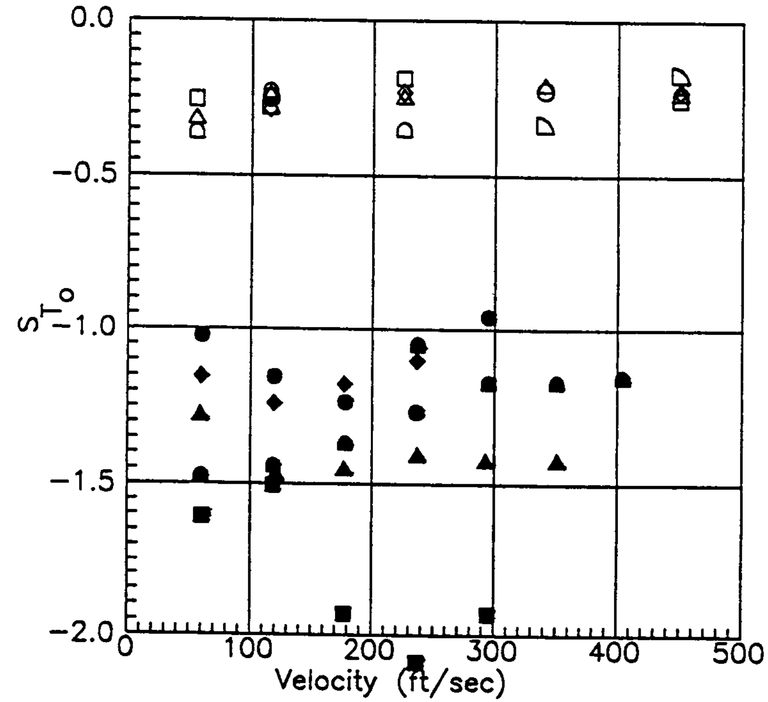

Figure 37.9 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, P−wire, To = 120 F
(Data corrected due to impedance)

Symbols:

Present	Density, #/ft³	Baldwin	Density, #/ft³
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

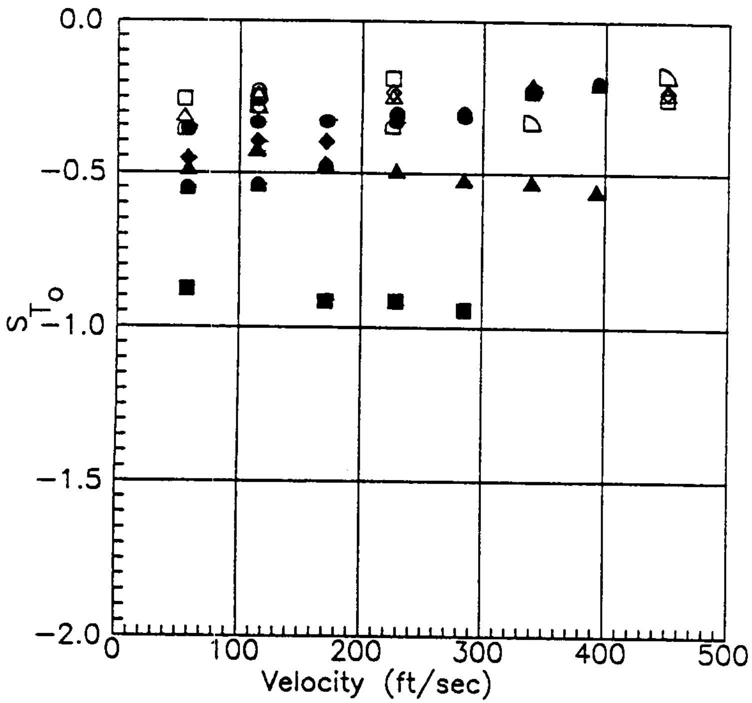

Figure 38.1 Velocity vs. S_{To}, $E = f(U,\rho,To)$, local fit
dw = 0.00015 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

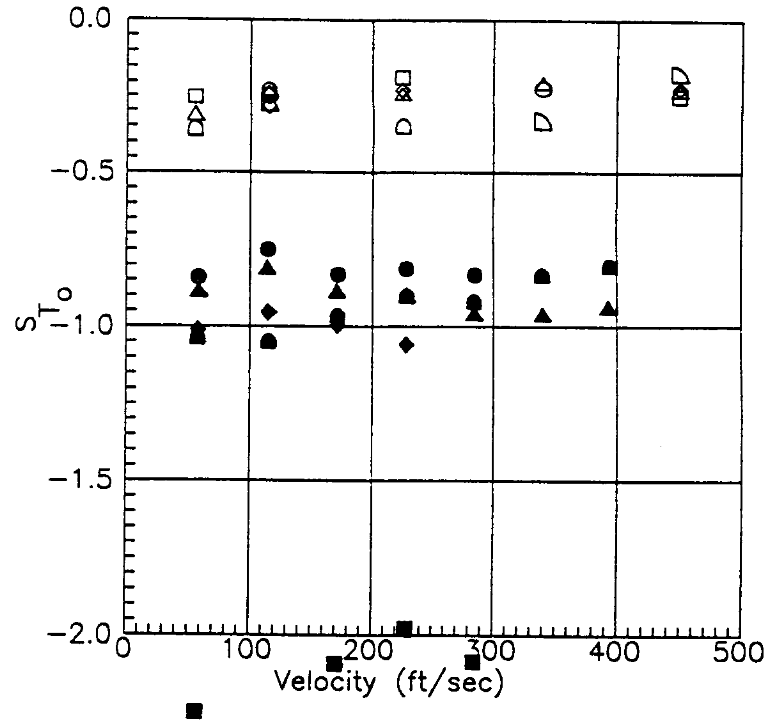

Figure 38.2 Velocity vs. S_{To}, $E = f(U,\rho,To)$, local fit
dw = 0.00032 inch, Y–wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

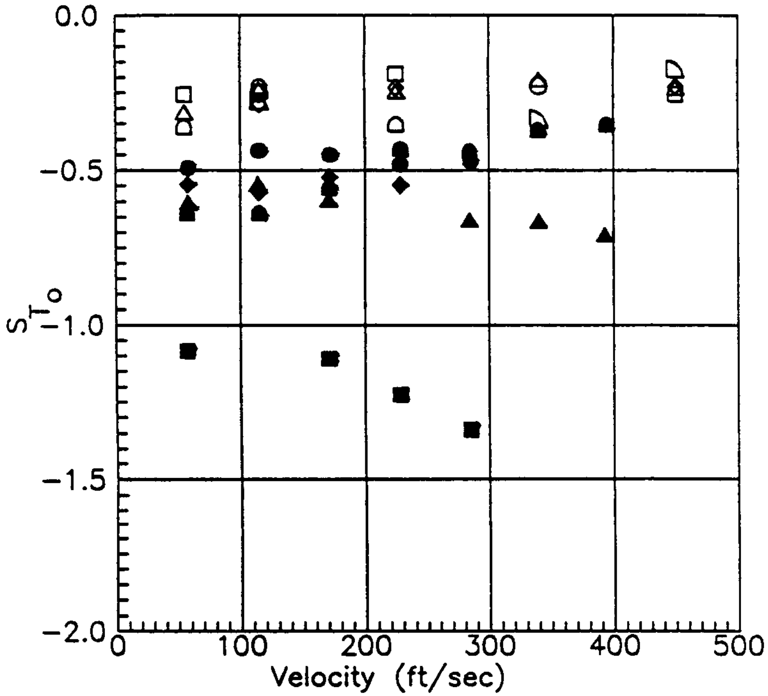

Figure 38.3 Velocity vs. S_{T_o}, $E = f(U,\rho,To)$, local fit
dw = 0.00050 inch, Y–wire, To = 80 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

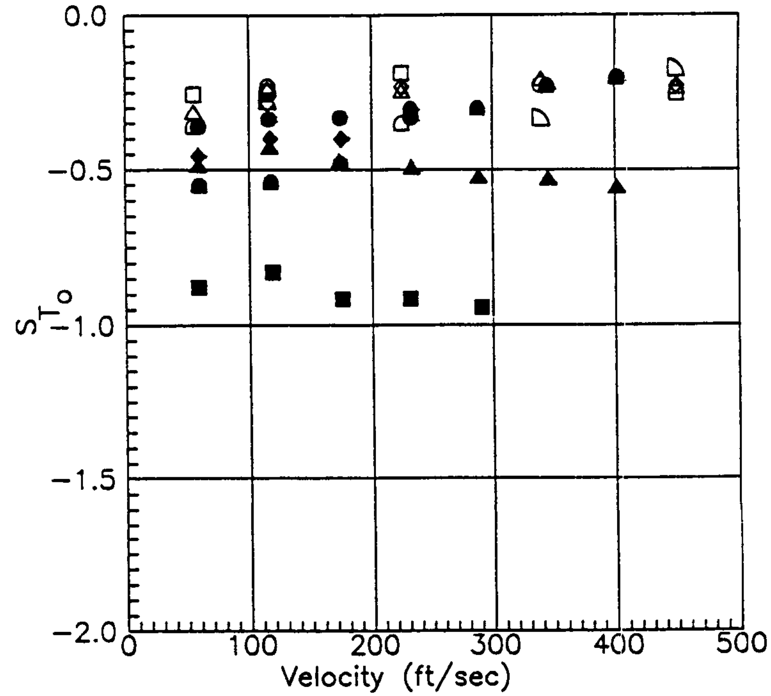

Figure 38.4 Velocity vs. S_{T_o}, $E = f(U,\rho,To)$, local fit
dw = 0.00015 inch, Y–wire, To = 100 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

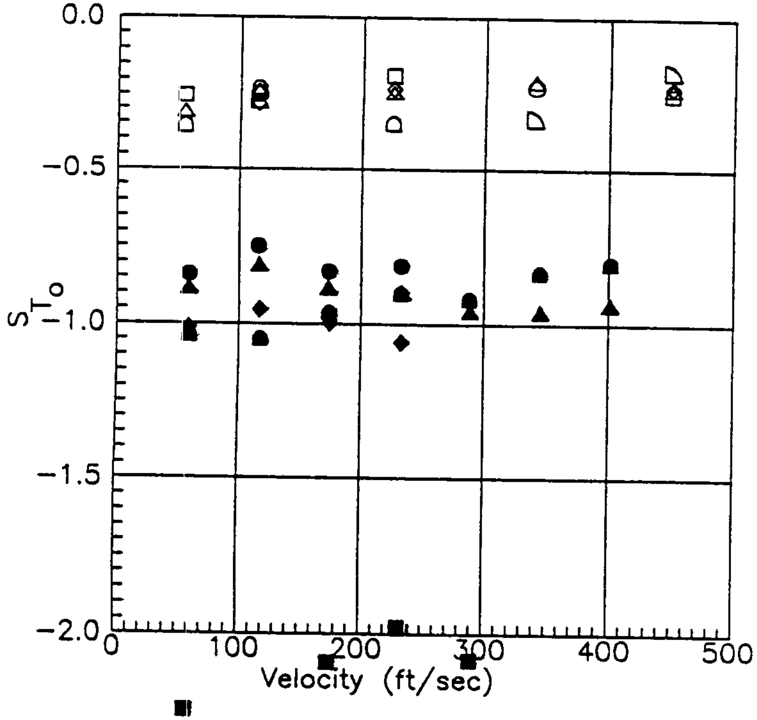

Figure 38.5 Velocity vs. S_{To}, E = f(U,ρ,To), local fit
dw = 0.00032 inch, Y–wire, To = 100 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

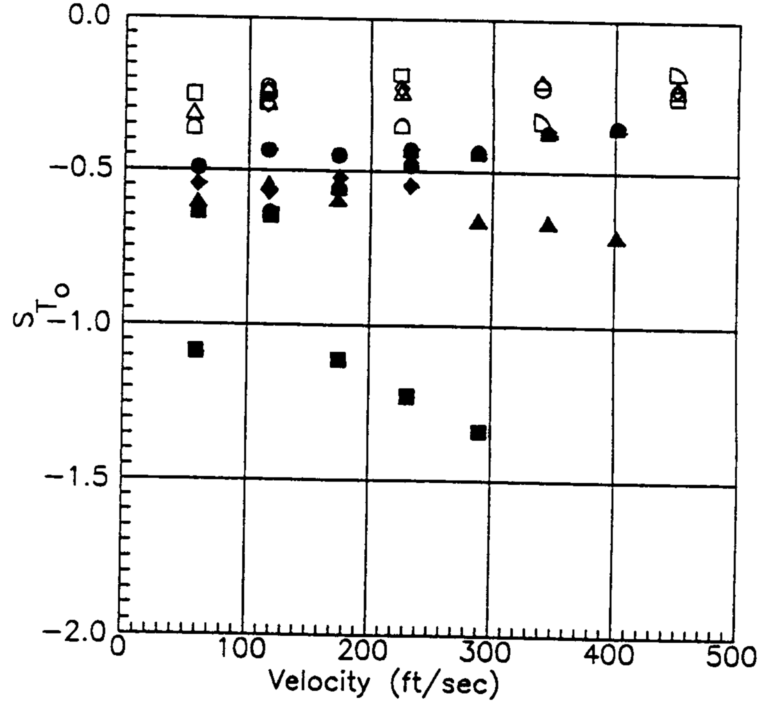

Figure 38.6 Velocity vs. S_{To}, E = f(U,ρ,To), local fit
dw = 0.00050 inch, Y–wire, To = 100 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

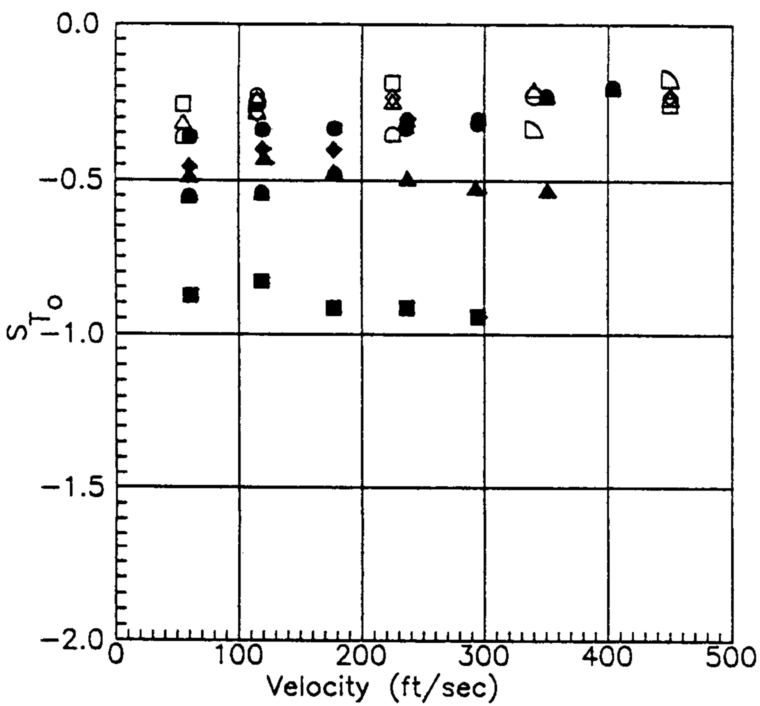

Figure 38.7 Velocity vs. S_{T_o}; $E = f(U, \rho, T_o)$, local fit
dw = 0.00015 inch, Y-wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◌	0.012
▲	0.074	◇	0.015
■	0.142	◌	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

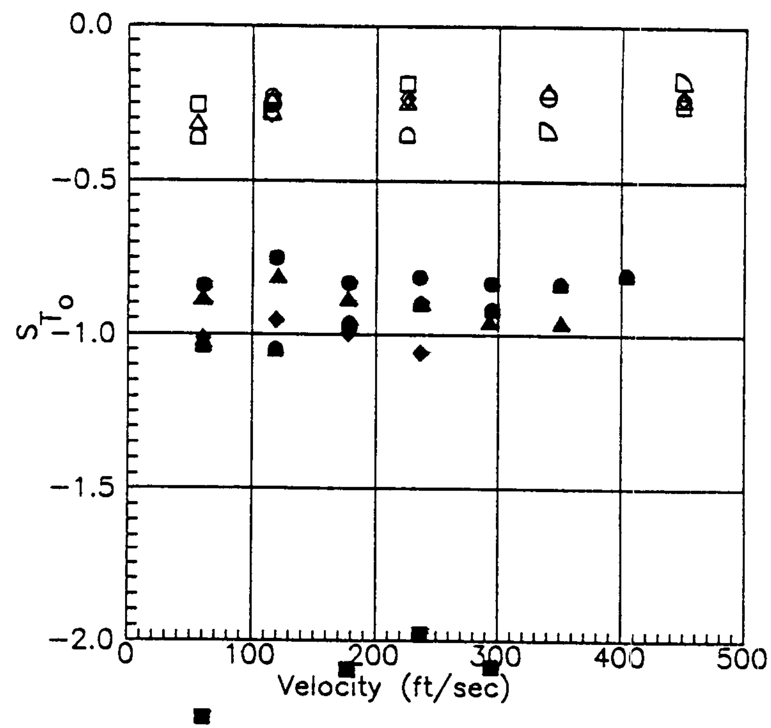

Figure 38.8 Velocity vs. S_{T_o}; $E = f(U, \rho, T_o)$, local fit
dw = 0.00032 inch, Y-wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◌	0.012
▲	0.074	◇	0.015
■	0.142	◌	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

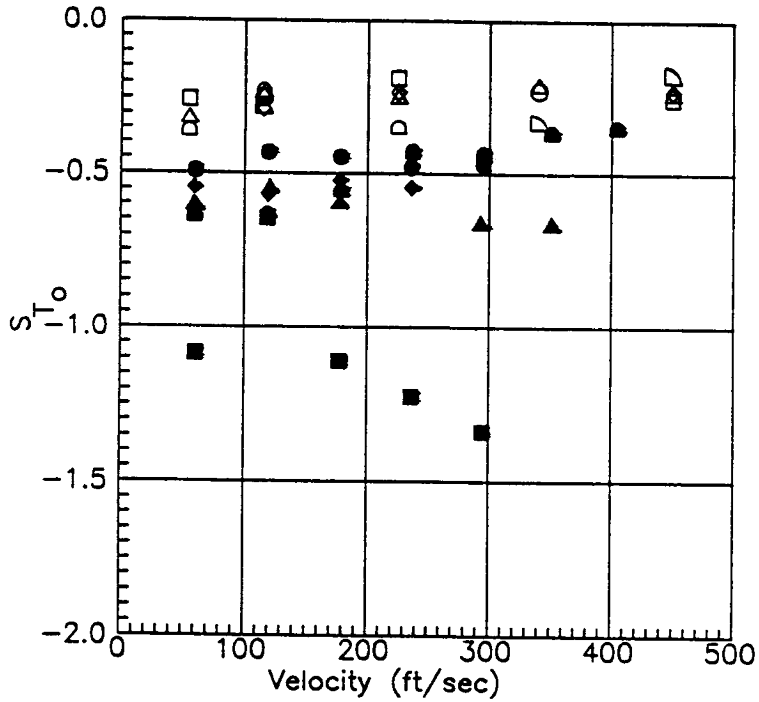

Figure 38.9 Velocity vs. S_{To}, $E = f(U,\rho,To)$, local fit
dw = 0.00050 inch, Y–wire, To = 120 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

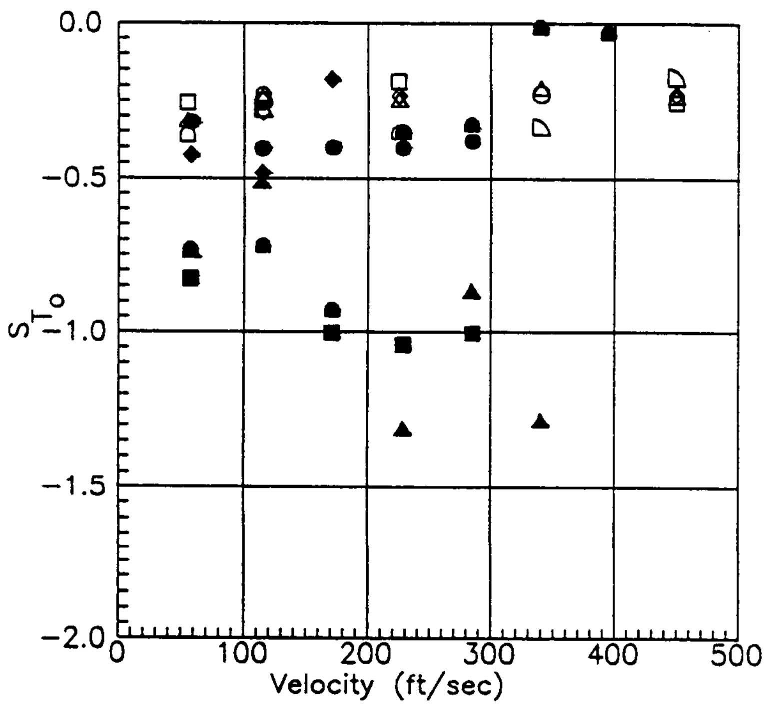

Figure 39.1 Velocity vs. S_{T_o}; Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, Y-wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

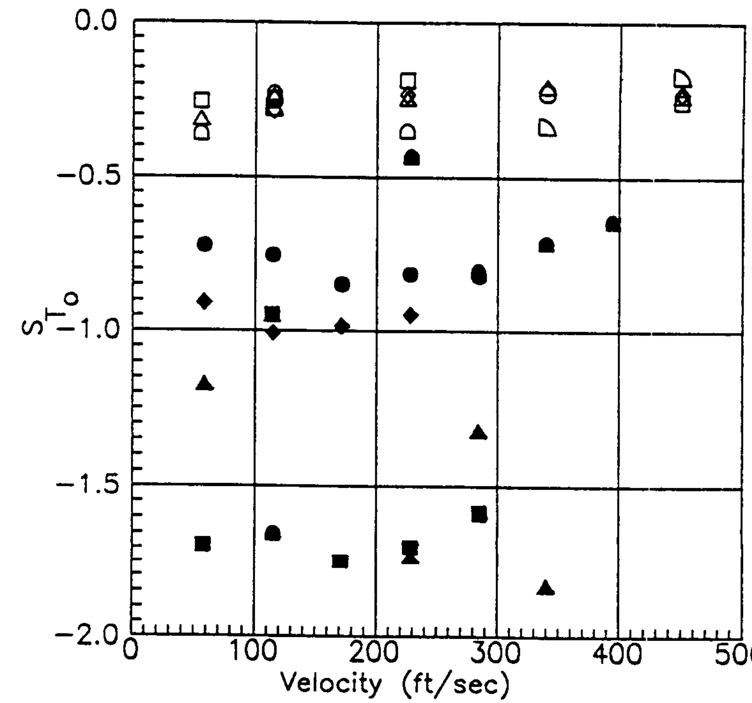

Figure 39.2 Velocity vs. S_{T_o}; Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, Y-wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
◓	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

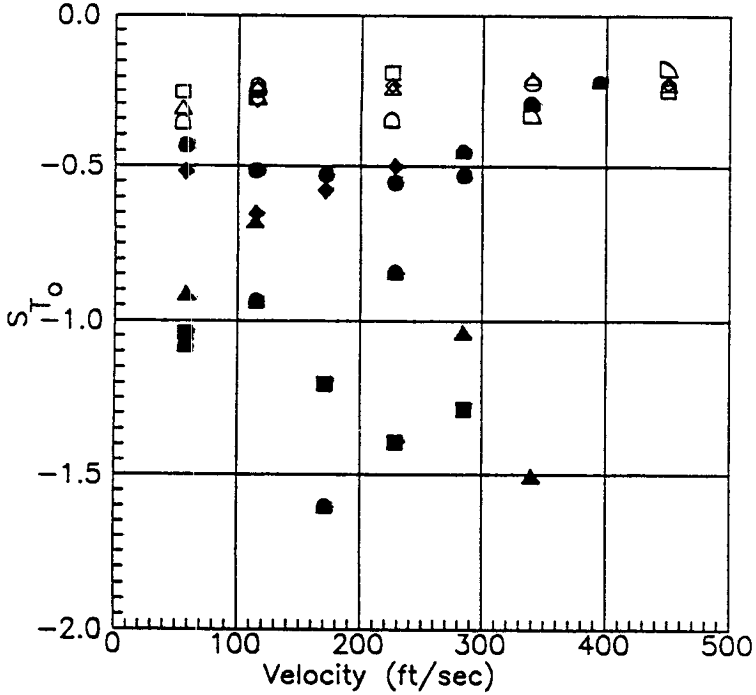

Figure 39.3 Velocity vs. S_{T_o}, Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, Y-wire, To = 80 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

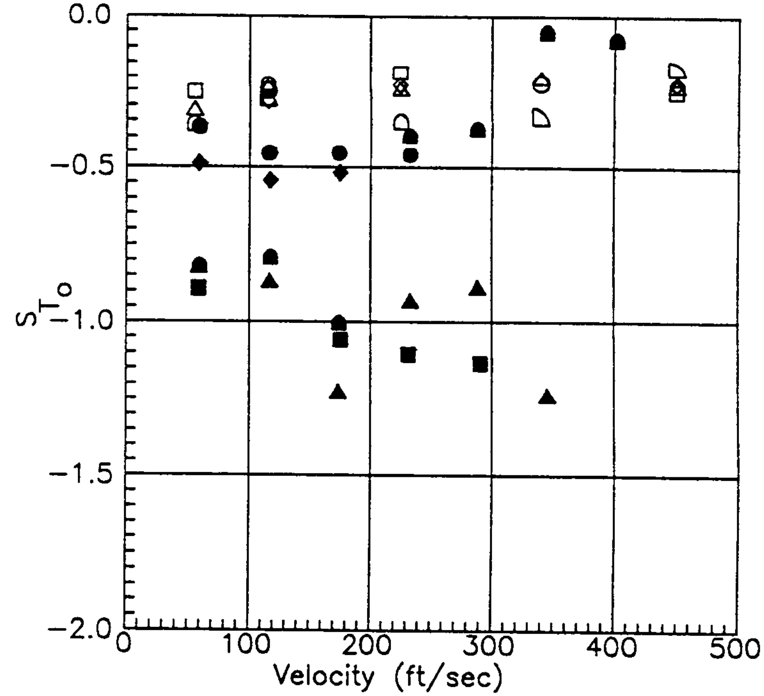

Figure 39.4 Velocity vs. S $_{To}$ Nut = f(M,Kn,); local fit
dw = 0.00015 inch, Y-wire, To = 100 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

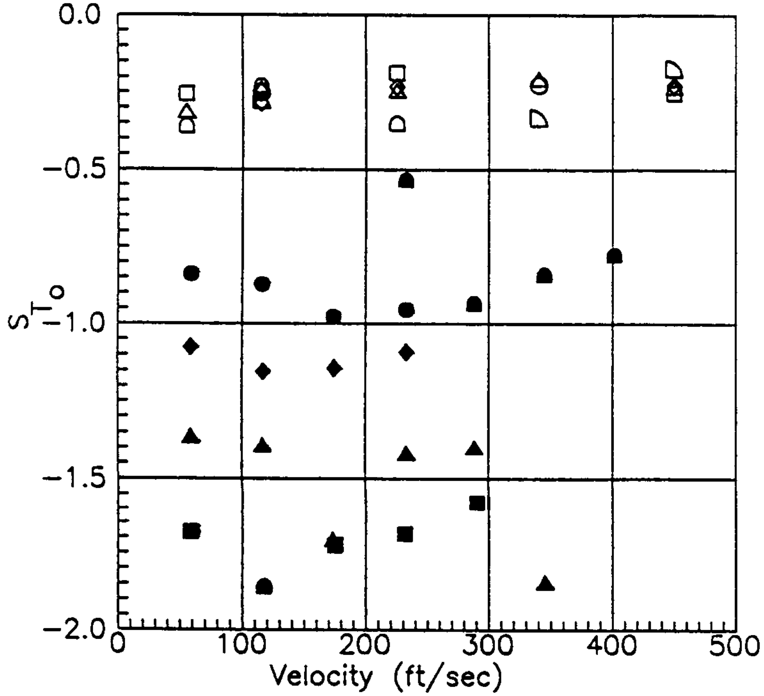

Figure 39.5 Velocity vs. S_{T_o}, Nut = f(M,Kn,τ), local fit
dw = 0.00032 inch, Y−wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

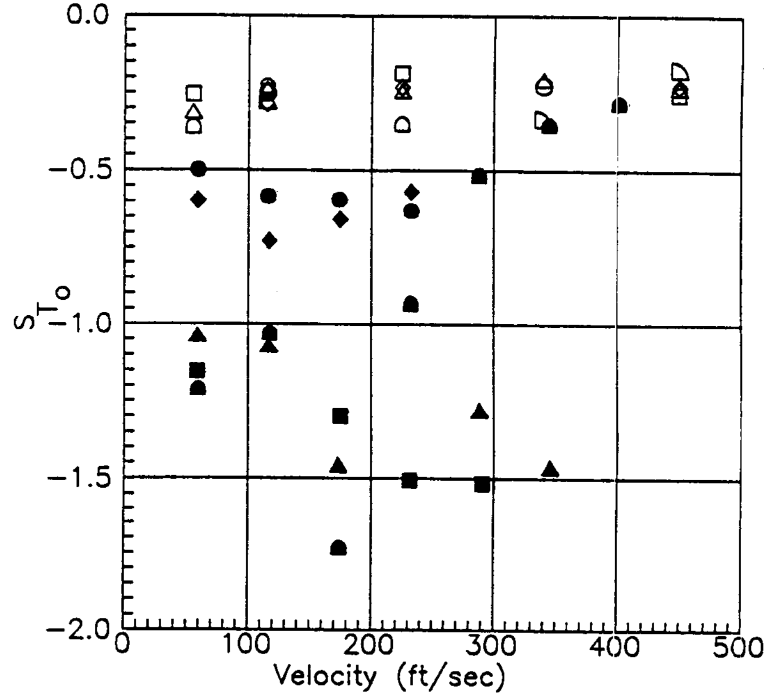

Figure 39.6 Velocity vs. S_{T_o}, Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, Y−wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

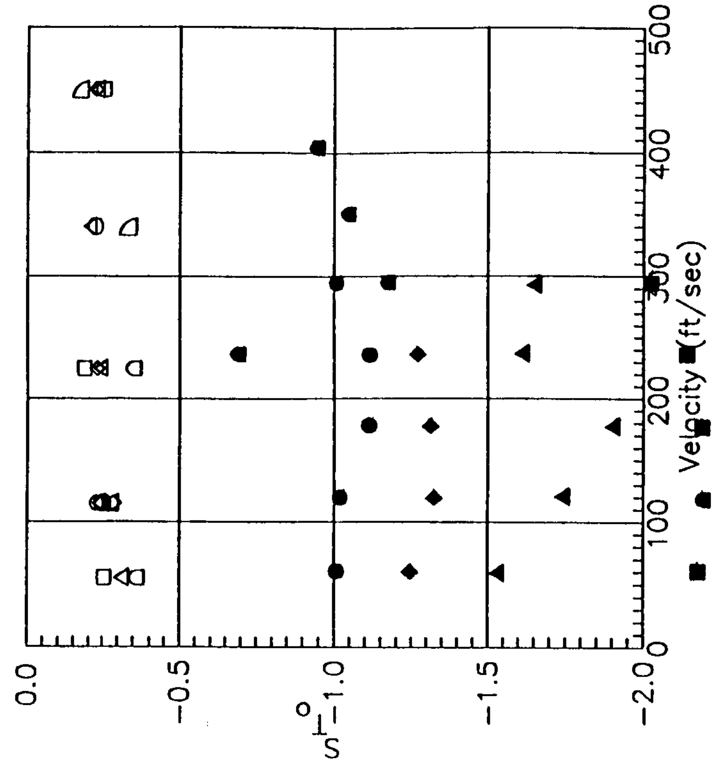

Figure 39.8 Velocity vs. S_{To}; Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, S–wire, To = 120 F

Symbols:

Present	Density,#/ft³	Baldwin	Density,#/ft³
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	◻	0.060
		○	0.095

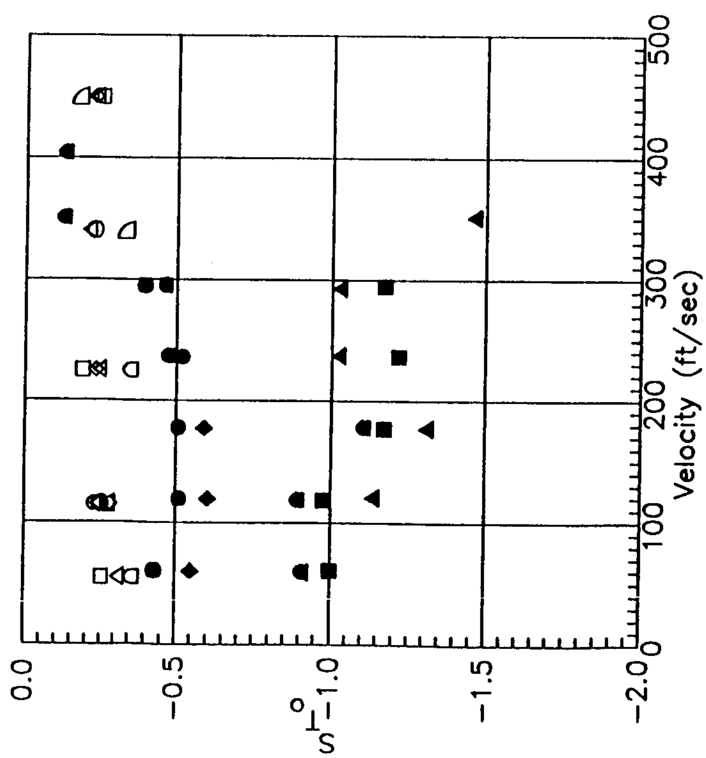

Figure 39.7 Velocity vs. S_{To}; Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, Y–wire, To = 120 F

Symbols:

Present	Density,#/ft³	Baldwin	Density,#/ft³
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	◻	0.060
		○	0.095

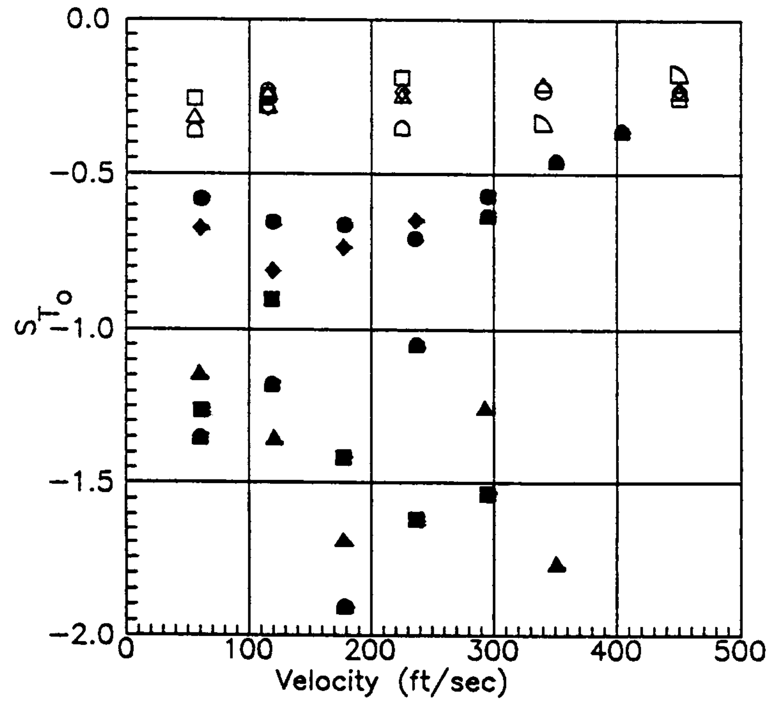

Figure 39.9 Velocity vs. S_{T_o}, Nut = f(M,Kn,τ), local fit
dw = 0.00050 inch, Y-wire, To = 120 F

Symbols:

Present	Density, #/ft³	Baldwin	Density, #/ft³
⬟	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

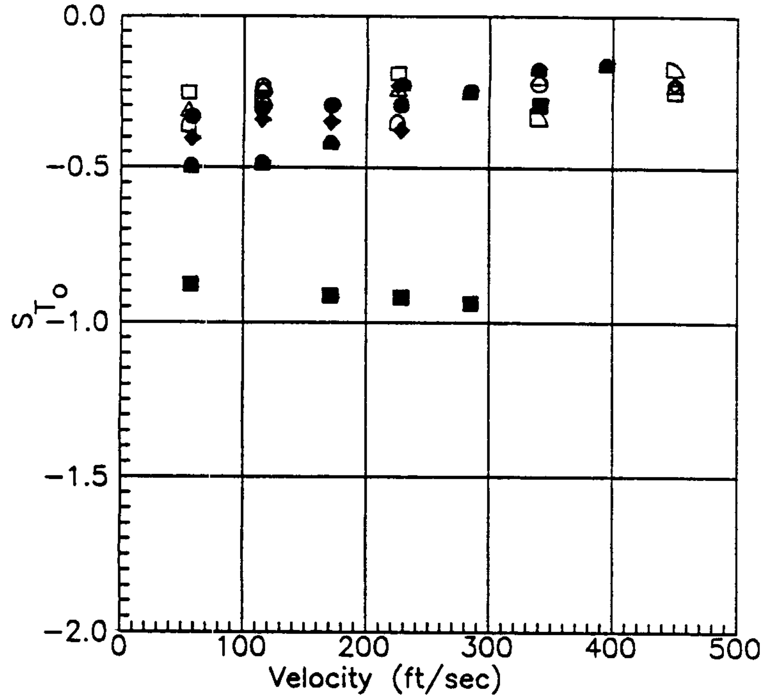

Figure 40.1 Velocity vs. S_{To}, $E = f(U,\rho,To)$, local fit
dw = 0.00015 inch, S−wire, To = 80 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
● (half-filled)	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

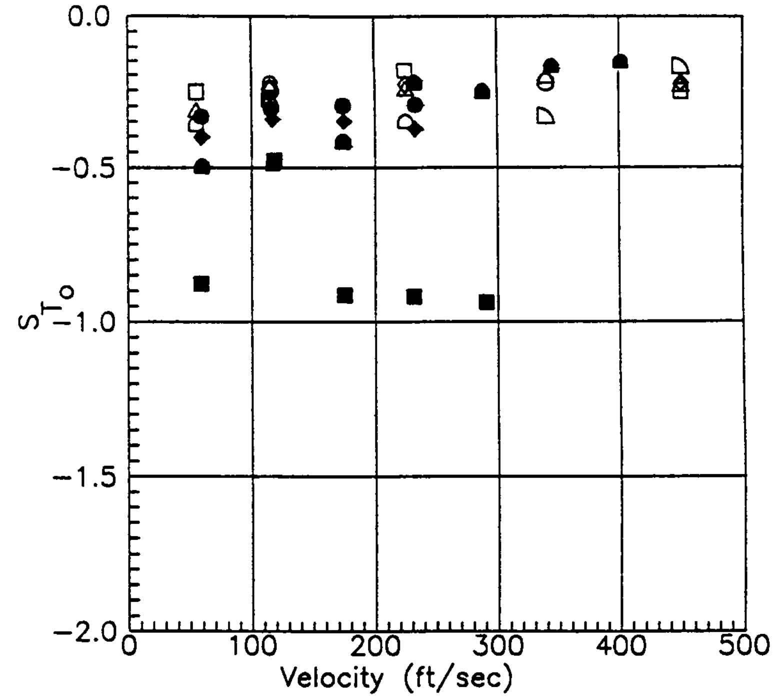

Figure 40.2 Velocity vs. S_{To}, $E = f(U,\rho,To)$, local fit
dw = 0.00015 inch, S−wire, To = 100 F

Symbols:

Present	Density, #/ft^3	Baldwin	Density, #/ft^3
● (half-filled)	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◠	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

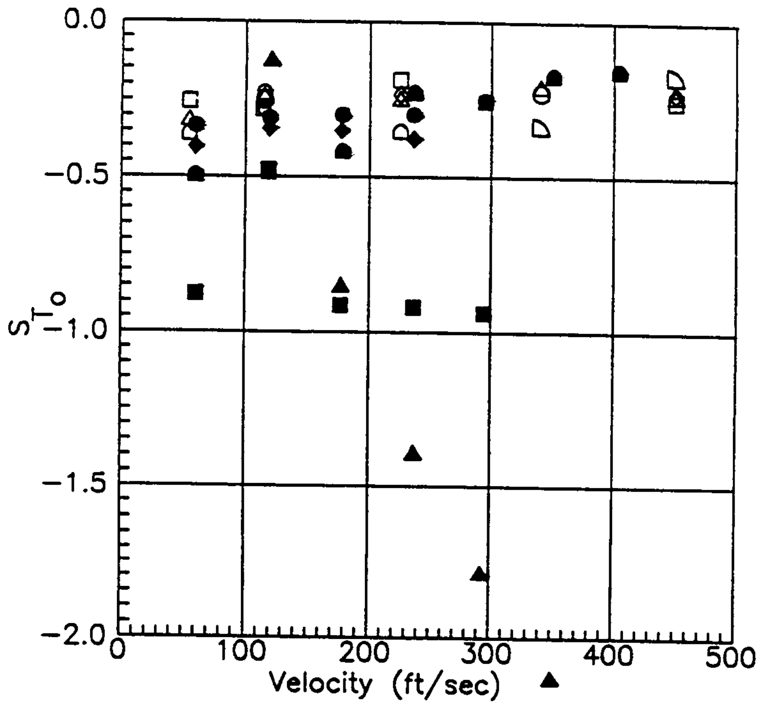

Figure 40.3 Velocity vs. S_{To}, $E = f(U, \rho, To)$, local fit
dw = 0.00015 inch, S-wire, To = 120 F

Symbols:

Present	Density, #/ft³	Baldwin	Density, #/ft³
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	◻	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

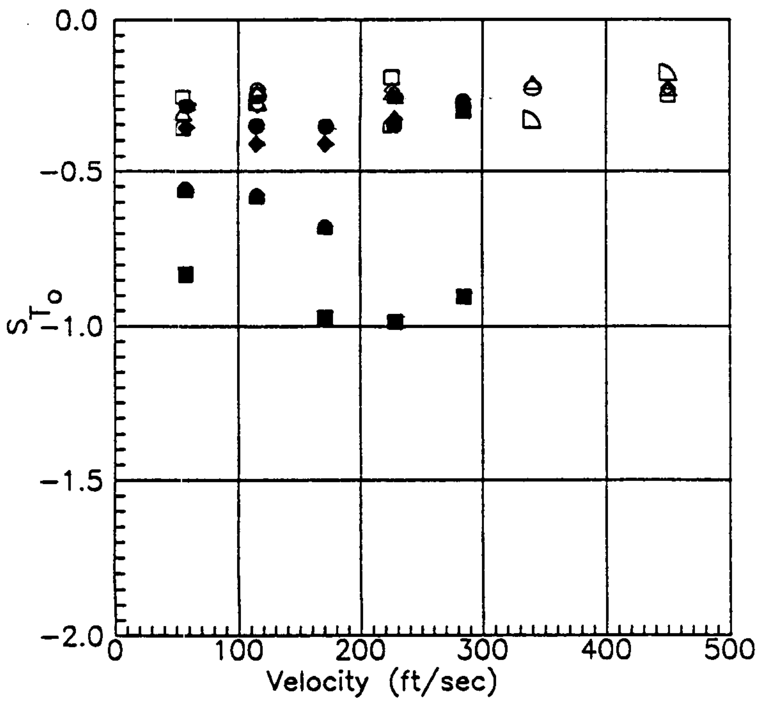

Figure 41.1 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, S-wire, To = 80 F

Symbols:

Present	Density,#/ft³	Baldwin	Density,#/ft³
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

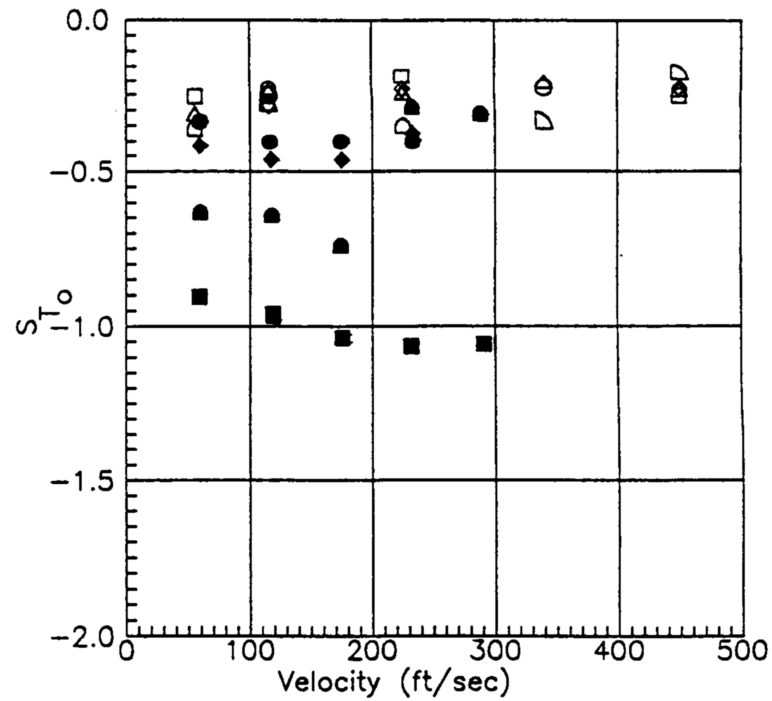

Figure 41.2 Velocity vs. S_{To}, Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, S-wire, To = 100 F

Symbols:

Present	Density,#/ft³	Baldwin	Density,#/ft³
●	0.037	D	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

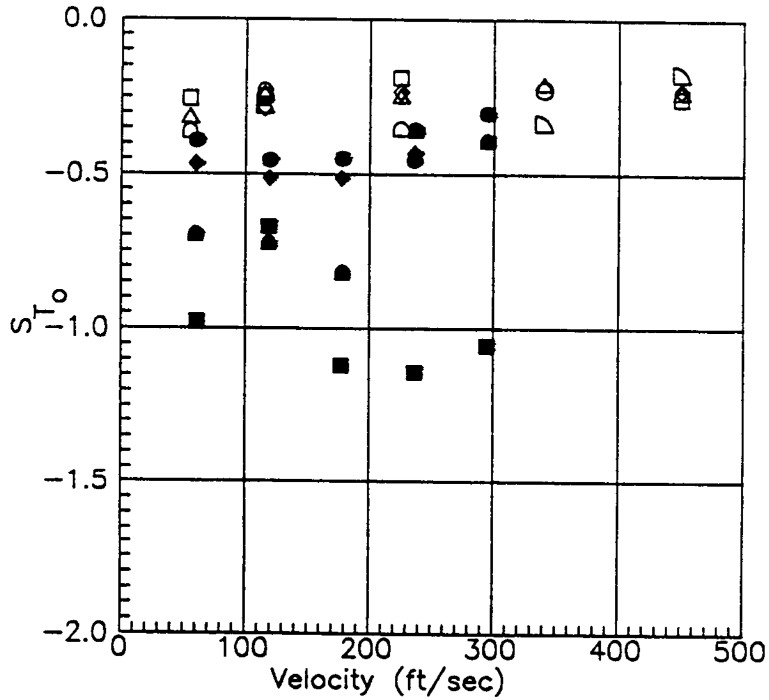

Figure 41.3 Velocity vs. S_{T_o}, Nut = f(M,Kn,τ), local fit
dw = 0.00015 inch, S−wire, To = 120 F

Symbols:

Present	Density,#/ft^3	Baldwin	Density,#/ft^3
●	0.037	◺	0.012
▲	0.074	◇	0.015
■	0.142	⌂	0.021
●	0.297	△	0.034
◆	0.560	□	0.060
		○	0.095

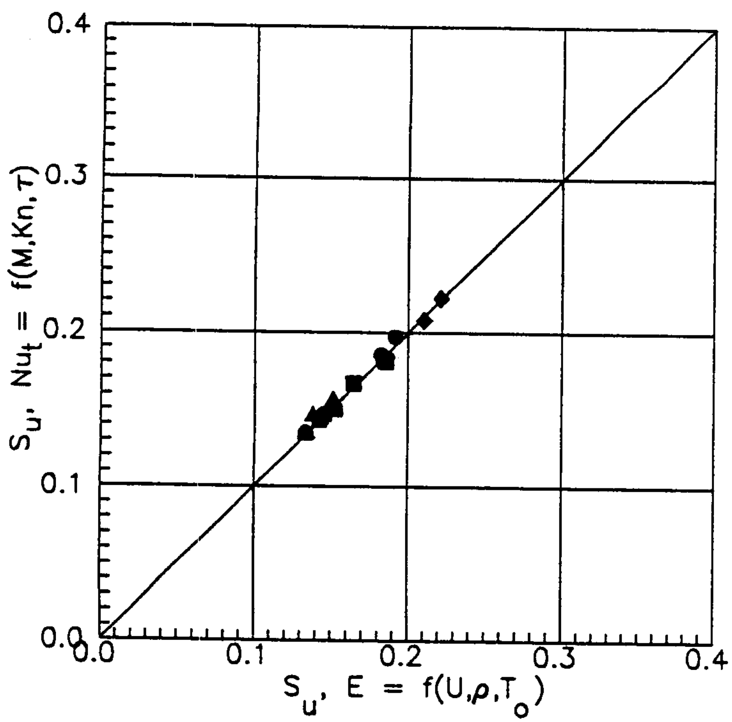

Figure 42.1 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, P–wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

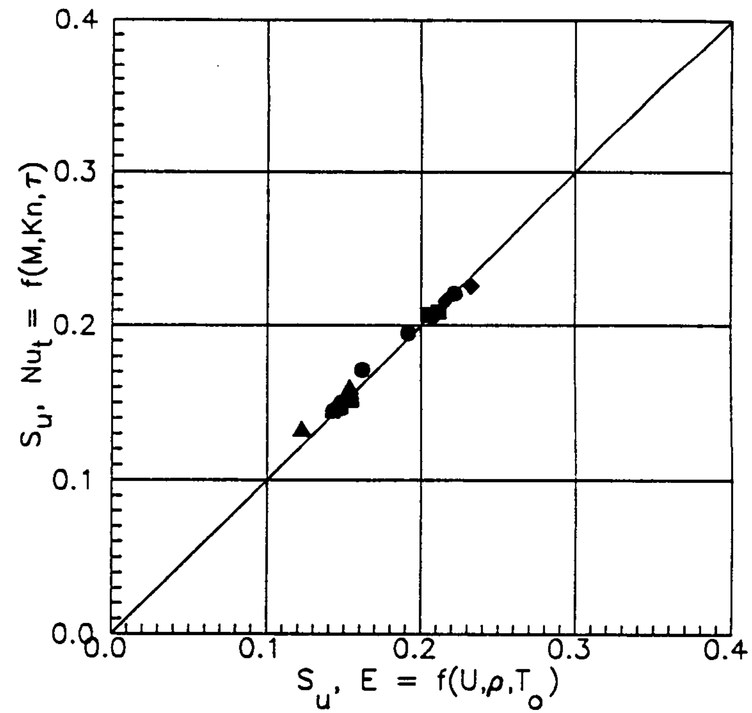

Figure 42.2 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00032 inch, P–wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

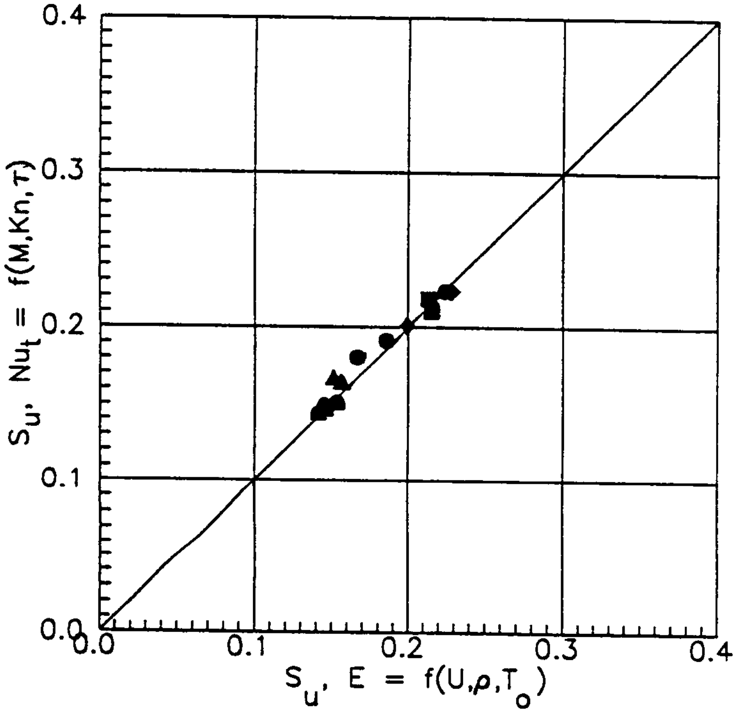

Figure 42.3 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00050 inch, P–wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

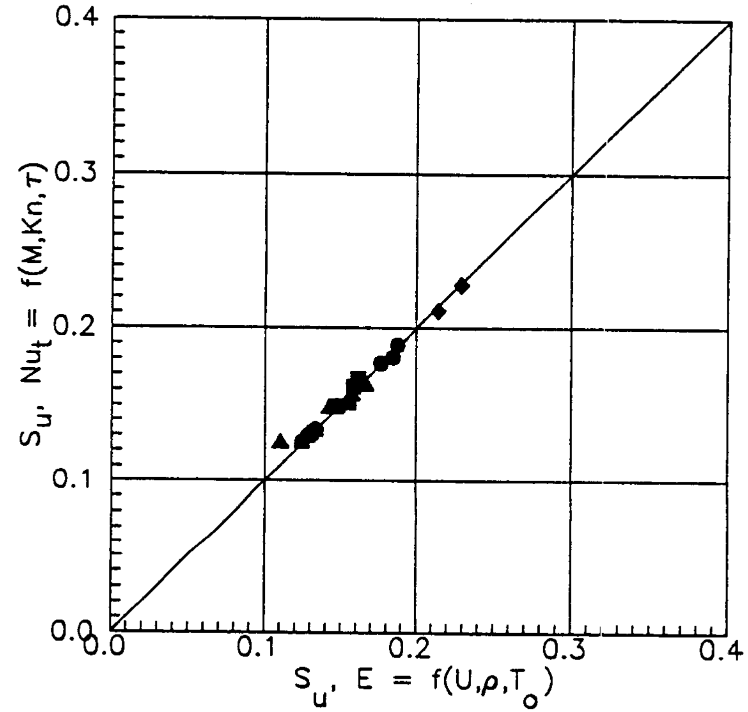

Figure 42.4 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, P–wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

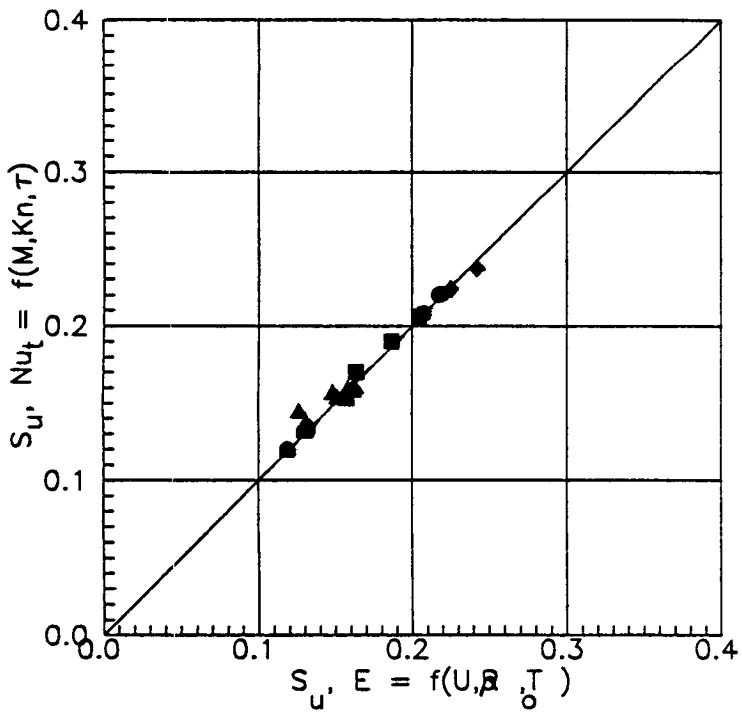

Figure 42.5 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00032 inch, P–wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1:00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

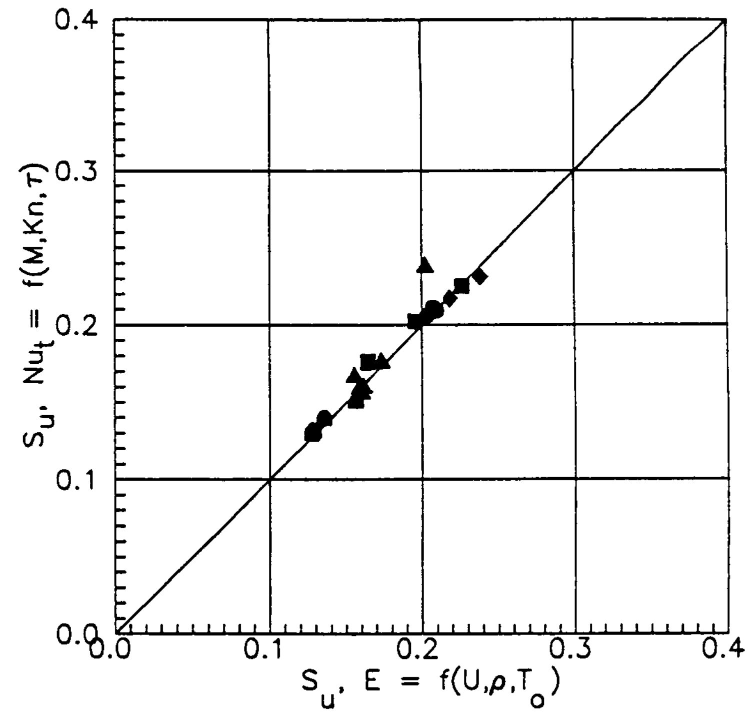

Figure 42.6 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00050 inch, P–wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

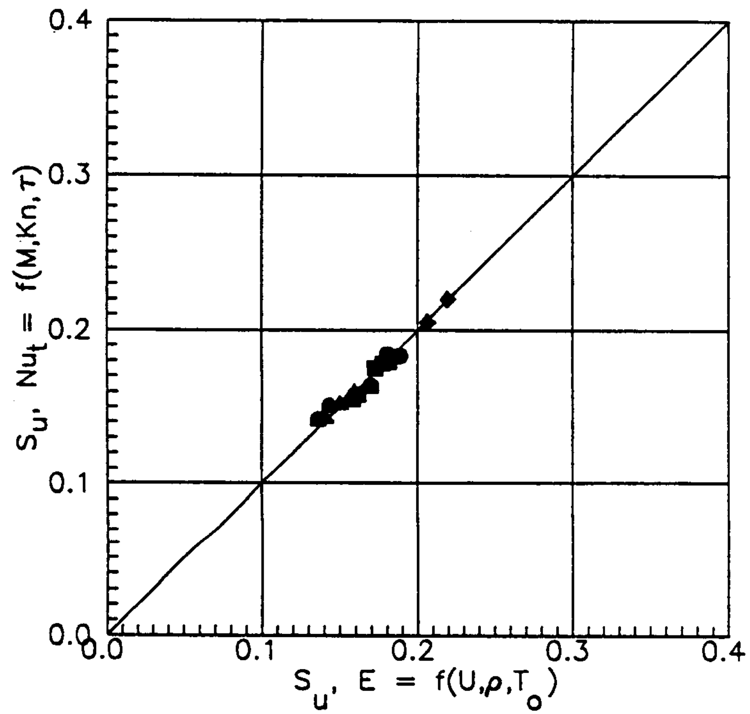

Figure 42.7 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, P–wire, T_o = 120 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

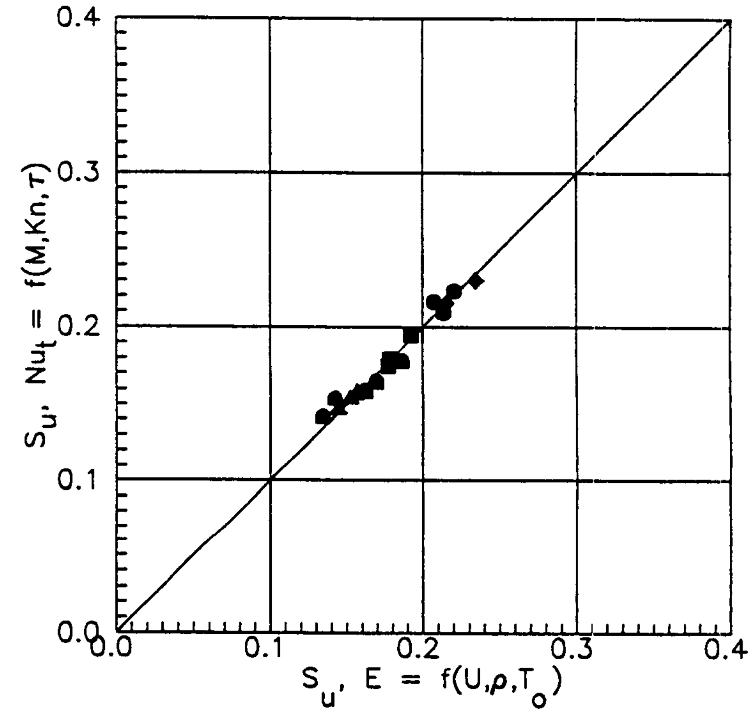

Figure 42.8 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00032 inch, P–wire, T_o = 120 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

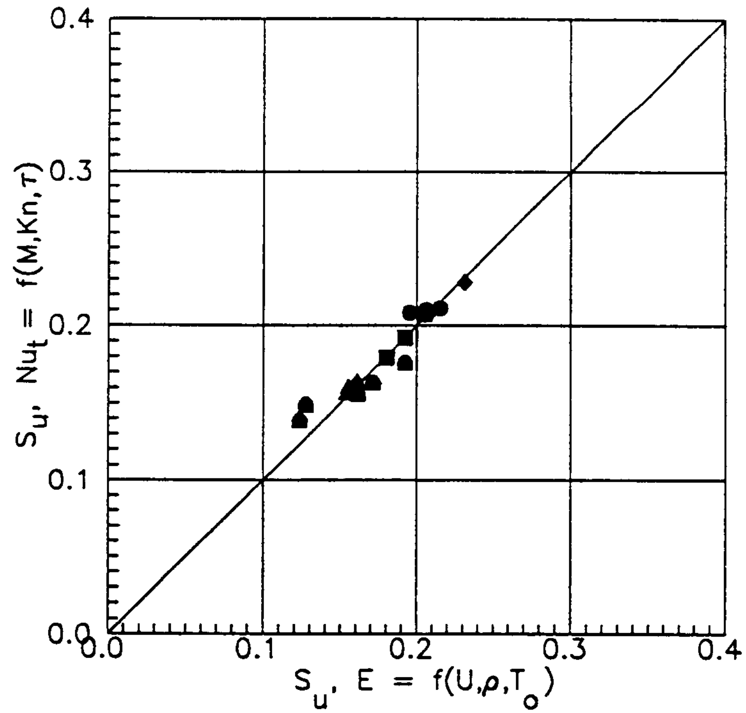

Figure 42.9 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00050 inch, P–wire, T_o = 120 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

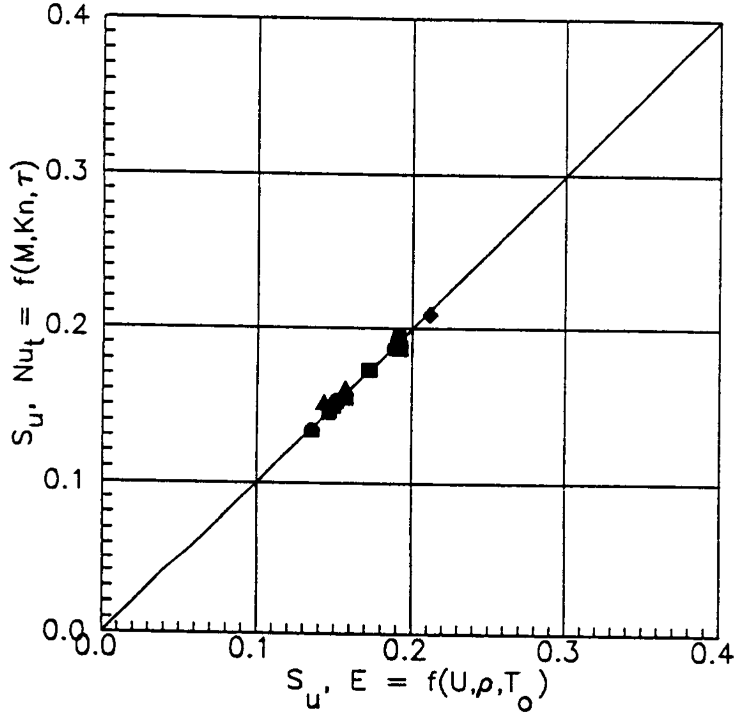

Figure 43.1 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, Y–wire, T_o = 80 F

Symbols: ⬟ 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

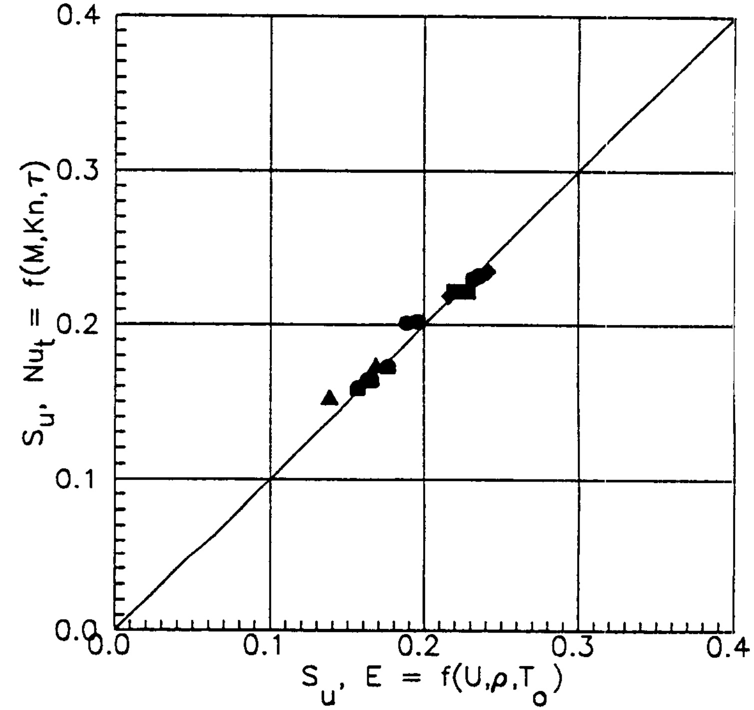

Figure 43.2 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00032 inch, Y–wire, T_o = 80 F

Symbols: ⬟ 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

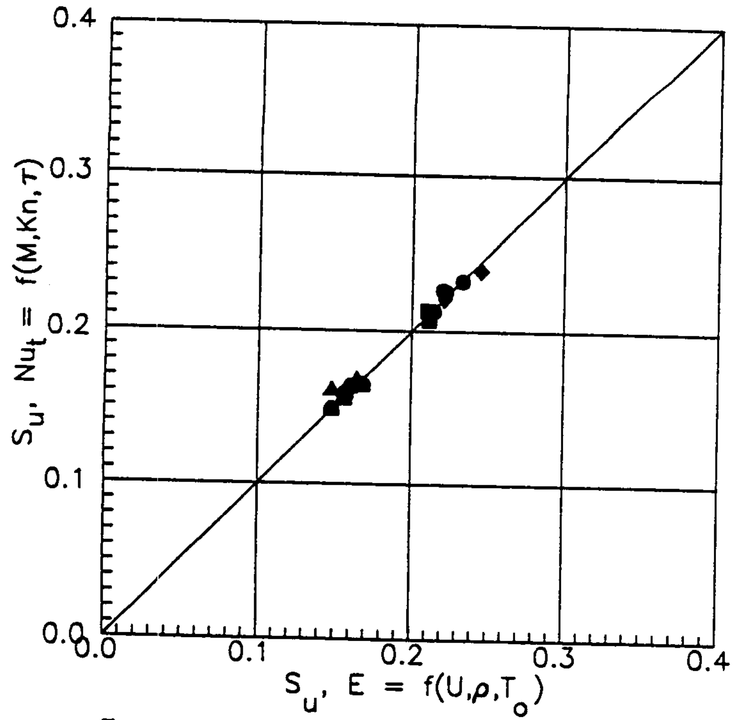

Figure 43.3 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00050 inch, Y-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

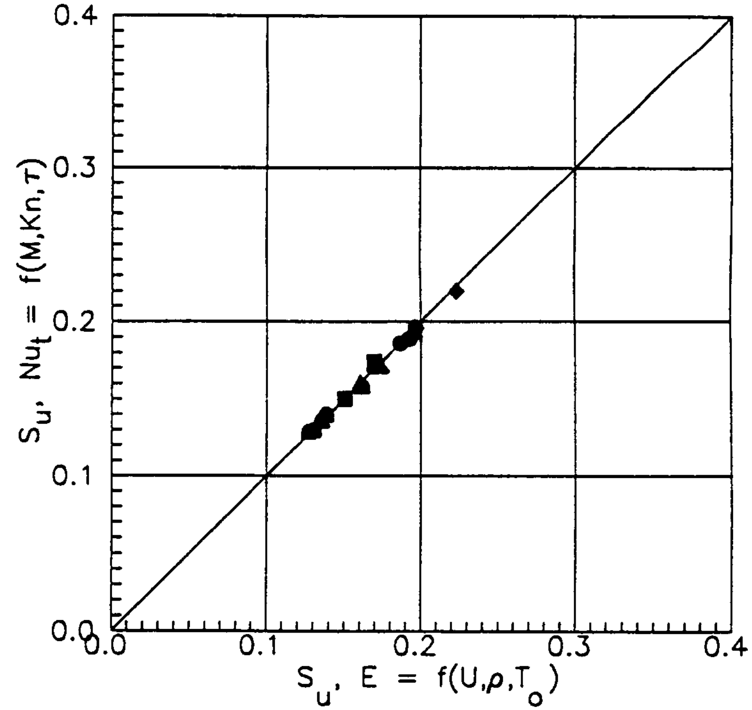

Figure 43.4 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, Y-wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

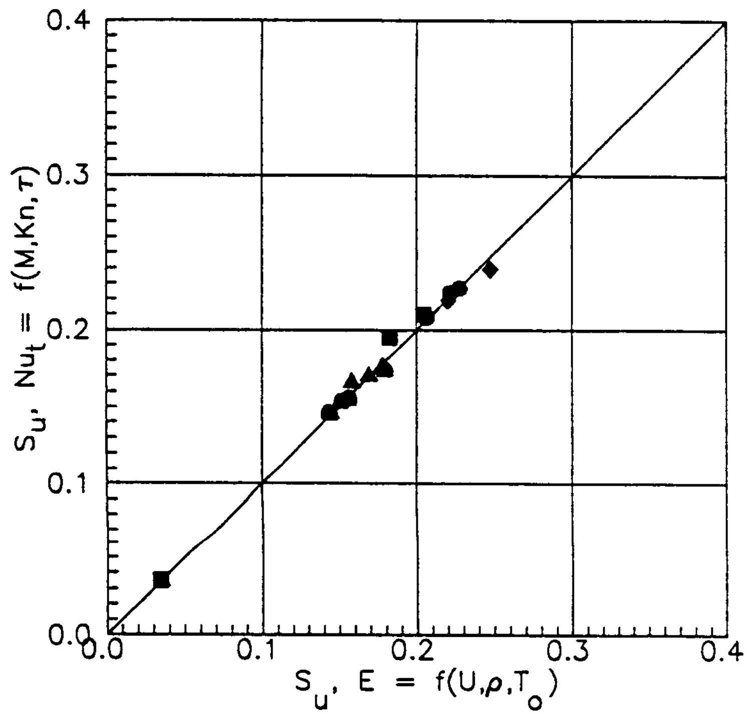

Figure 43.5 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00032 inch, Y-wire, T_o = 100 F

Symbols: 0.50 Atmosphere; 1.00 Atmosphere;
2.00 Atmosphere; 4.00 Atmosphere;
8.00 Atmosphere;

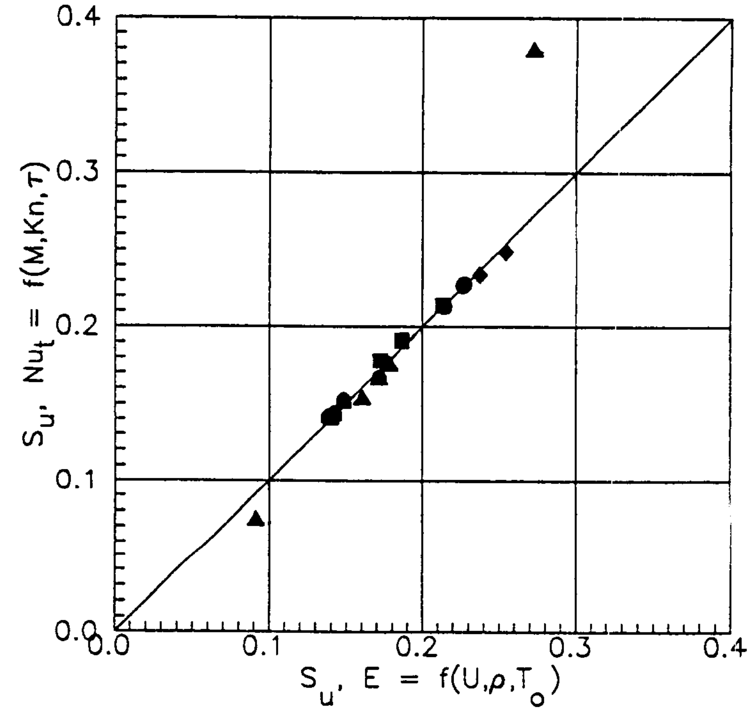

Figure 43.6 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00050 inch, Y-wire, T_o = 100 F

Symbols: 0.50 Atmosphere; 1.00 Atmosphere;
2.00 Atmosphere; 4.00 Atmosphere;
8.00 Atmosphere;

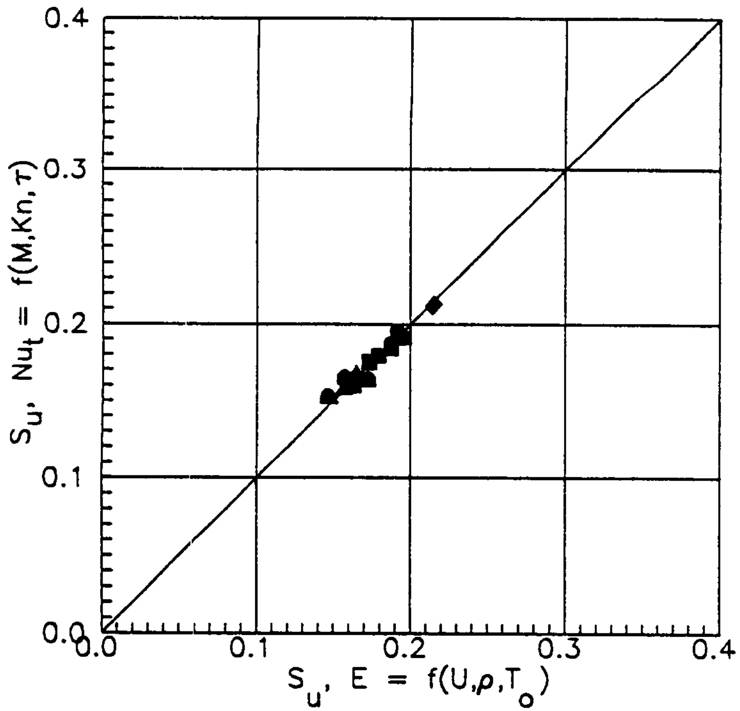

Figure 43.7 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, Y-wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

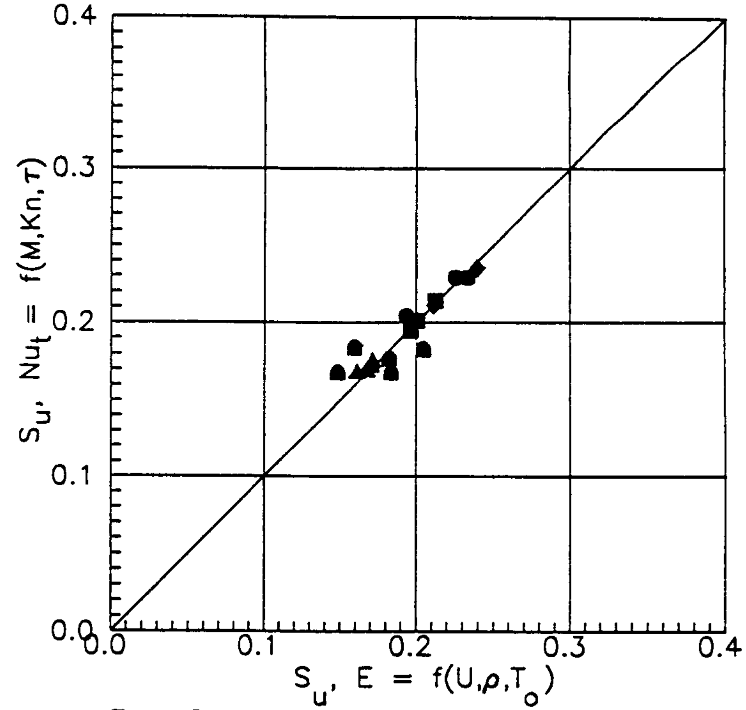

Figure 43.8 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00032 inch, Y-wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

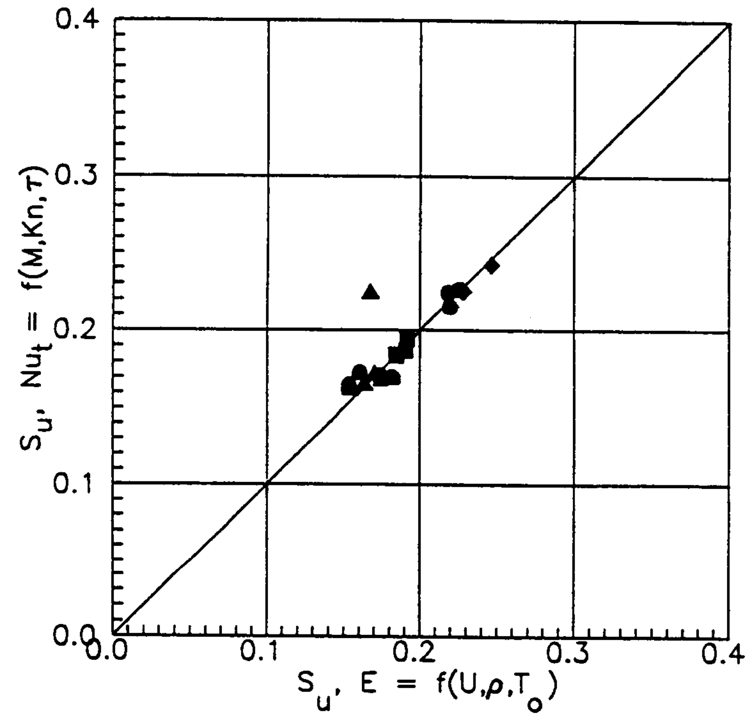

Figure 43.9 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00050 inch, Y-wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

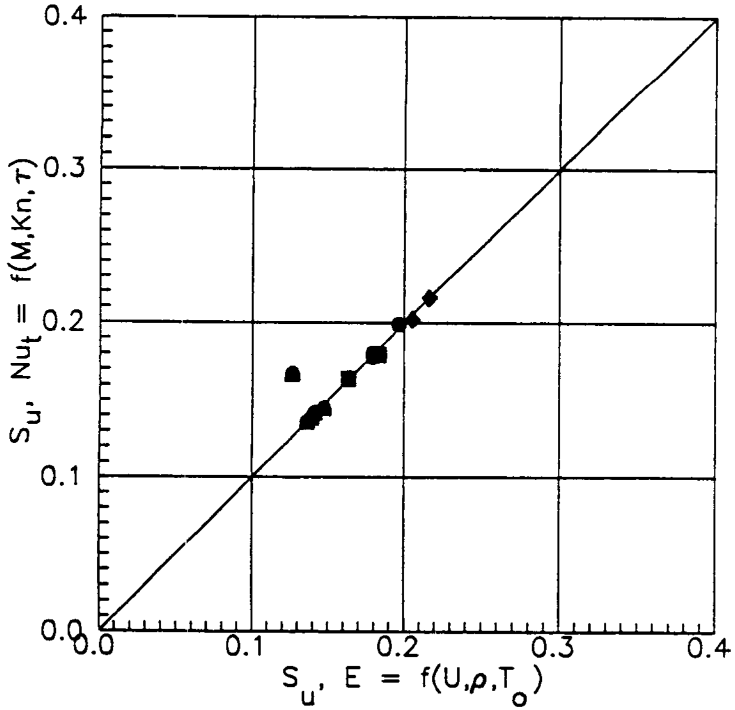

Figure 44.1 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, S-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

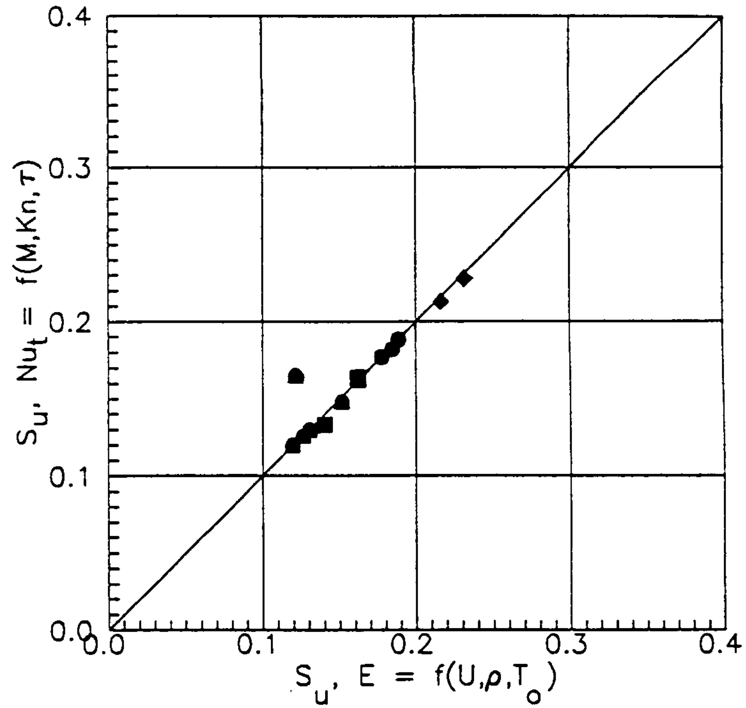

Figure 44.2 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, S-wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

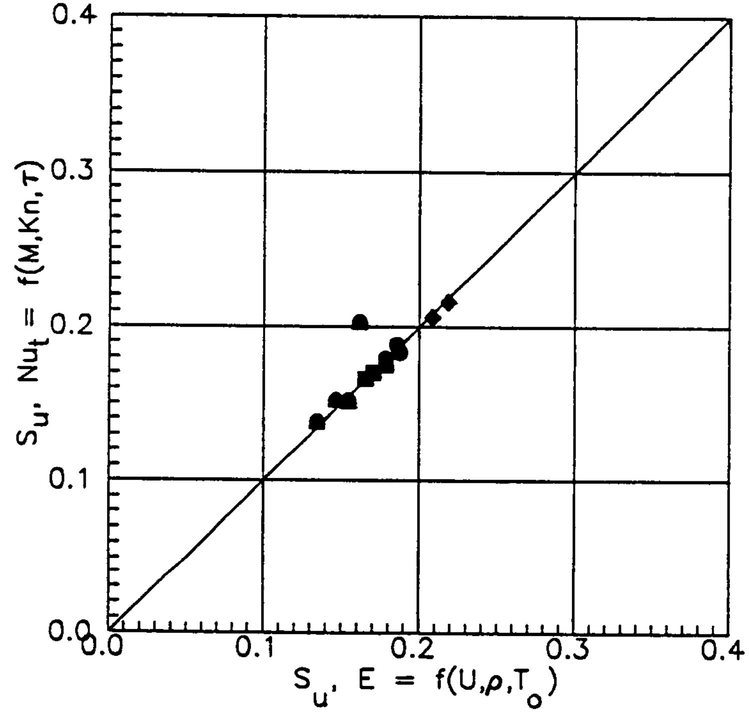

Figure 44.3 Velocity Sensitivity, 2nd degree local curve fit
dw = 0.00015 inch, S–wire, T_o = 120 F

Symbols: ⬟ 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

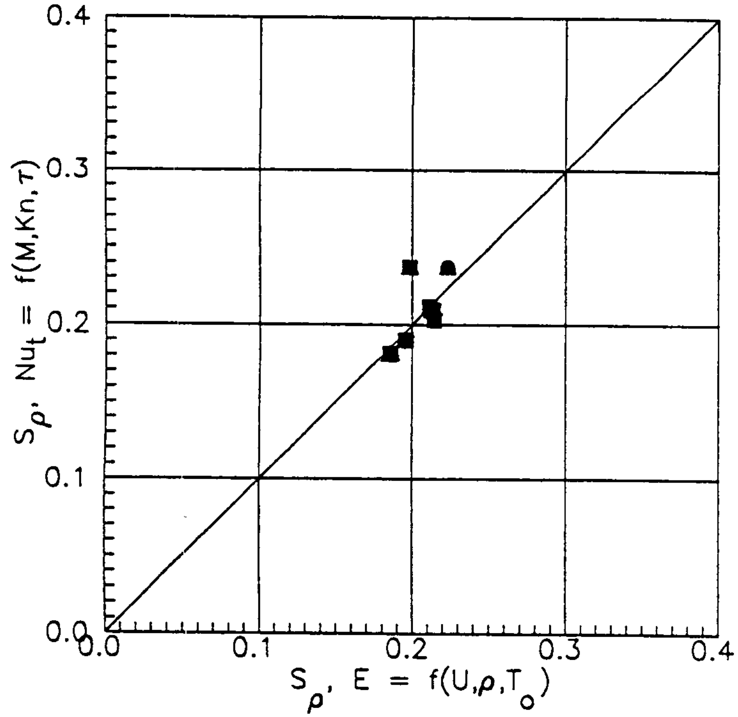

Figure 45.1 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, P–wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

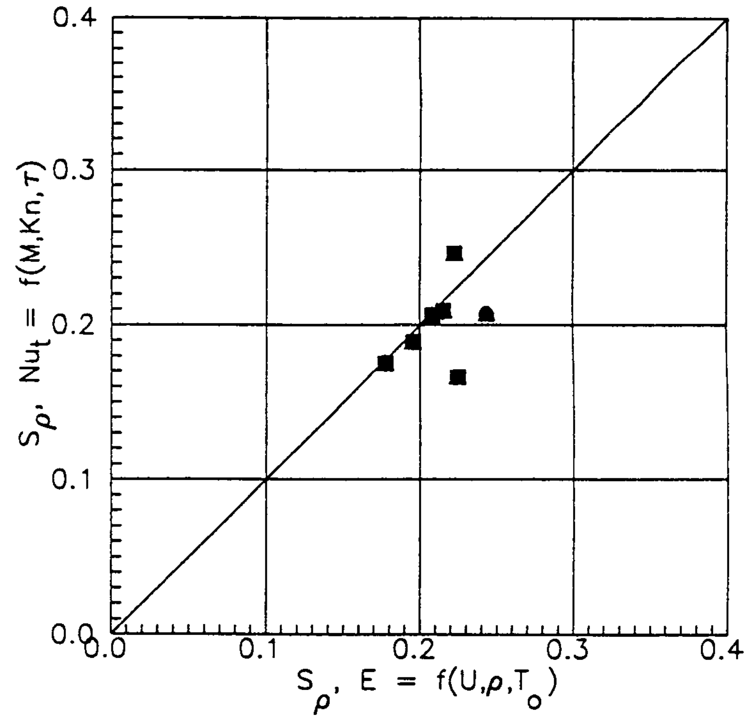

Figure 45.2 Density Sensitivity, Linear curve fit
dw = 0.00032 inch, P–wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

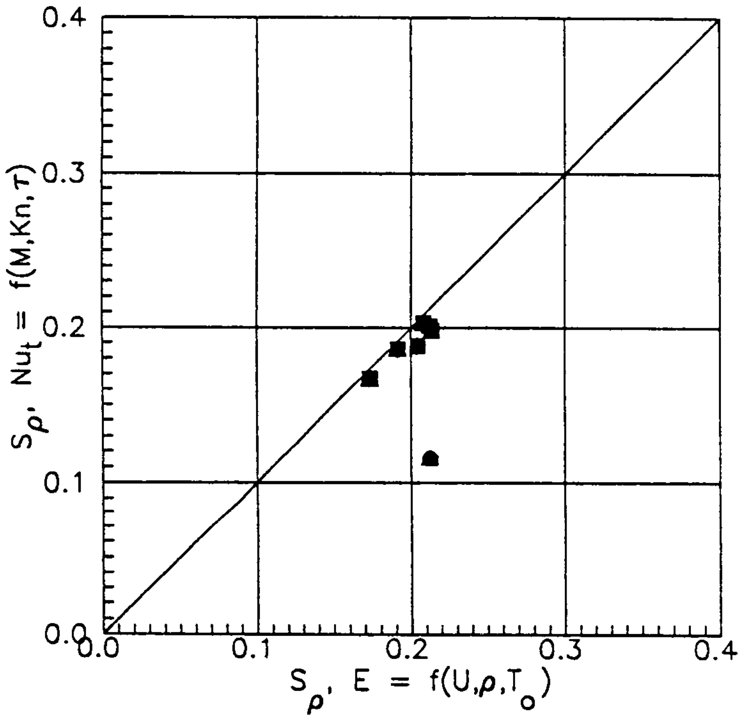

Figure 45.3 Density Sensitivity, Linear curve fit
dw = 0.00050 inch, P-wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ▲ 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

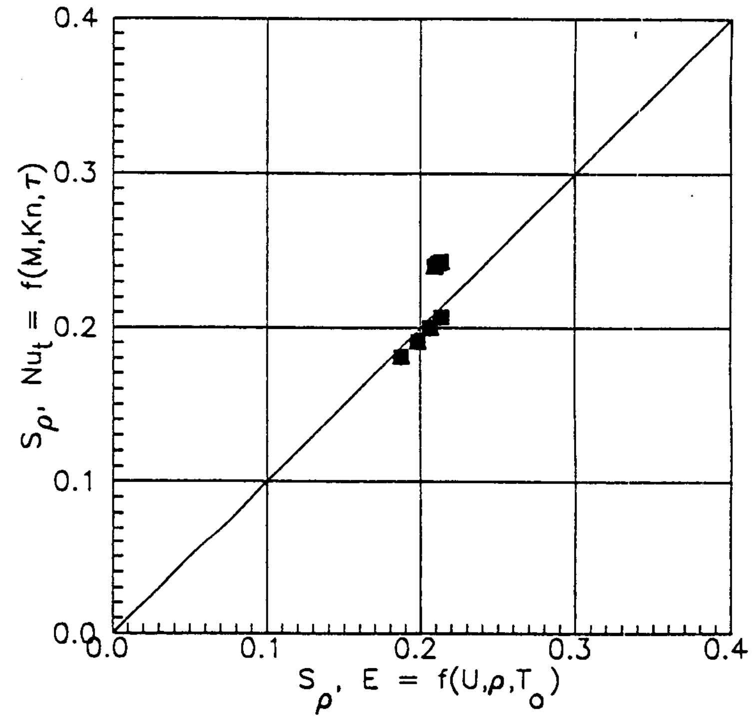

Figure 45.4 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, P-wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ▲ 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

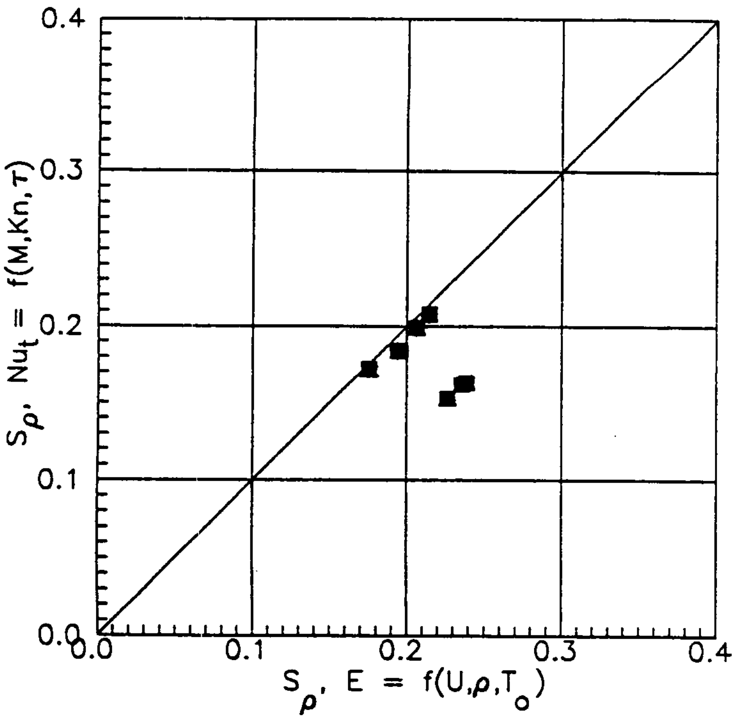

Figure 45.5 Density Sensitivity, Linear curve fit
dw = 0.00032 inch, P–wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

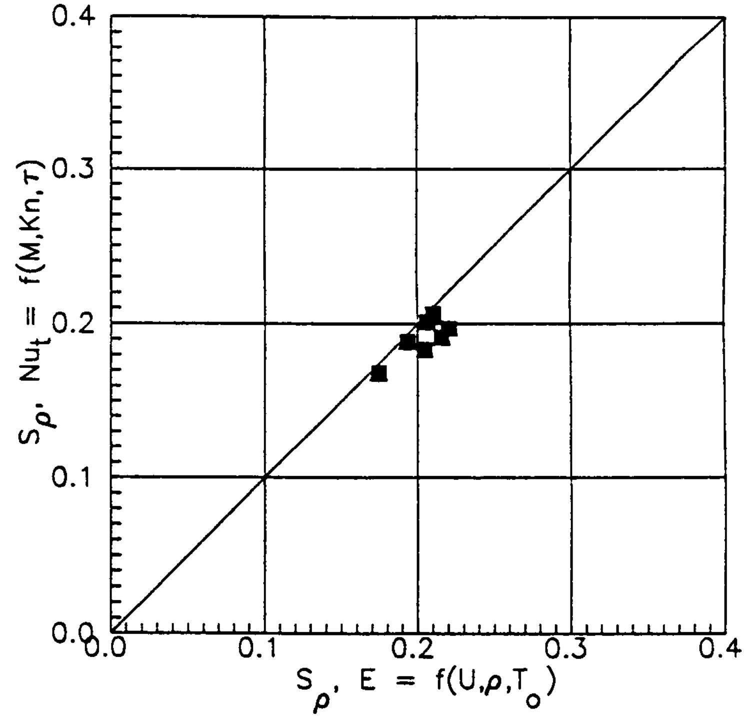

Figure 45.6 Density Sensitivity, Linear curve fit
dw = 0.00050 inch, P–wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

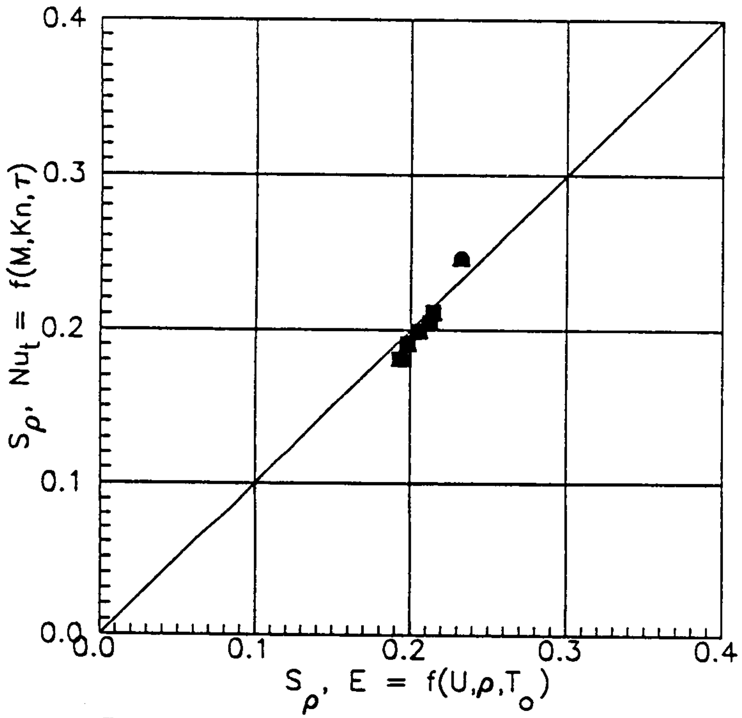

Figure 45.7 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, P–wire, T_o = 120 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

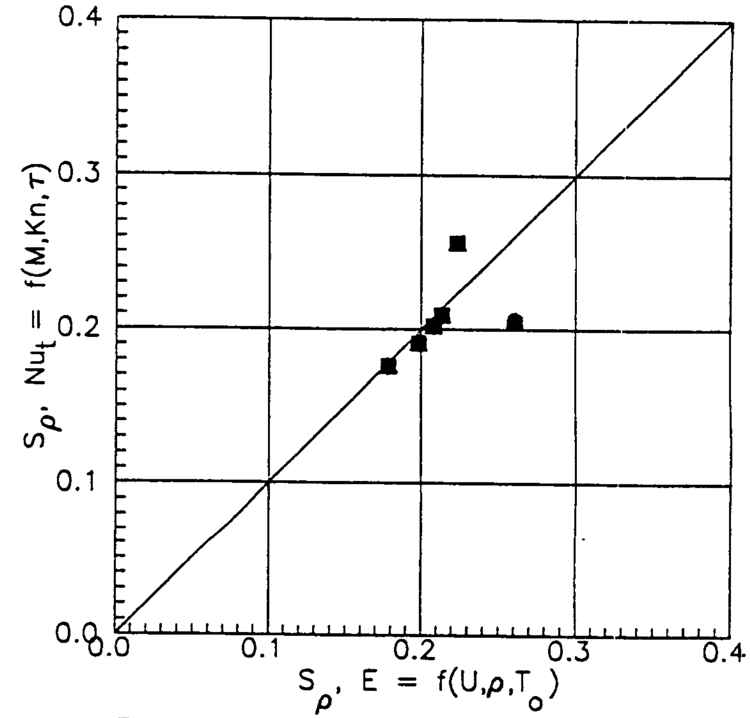

Figure 45.8 Density Sensitivity, Linear curve fit
dw = 0.00032 inch, P–wire, T_o = 120 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

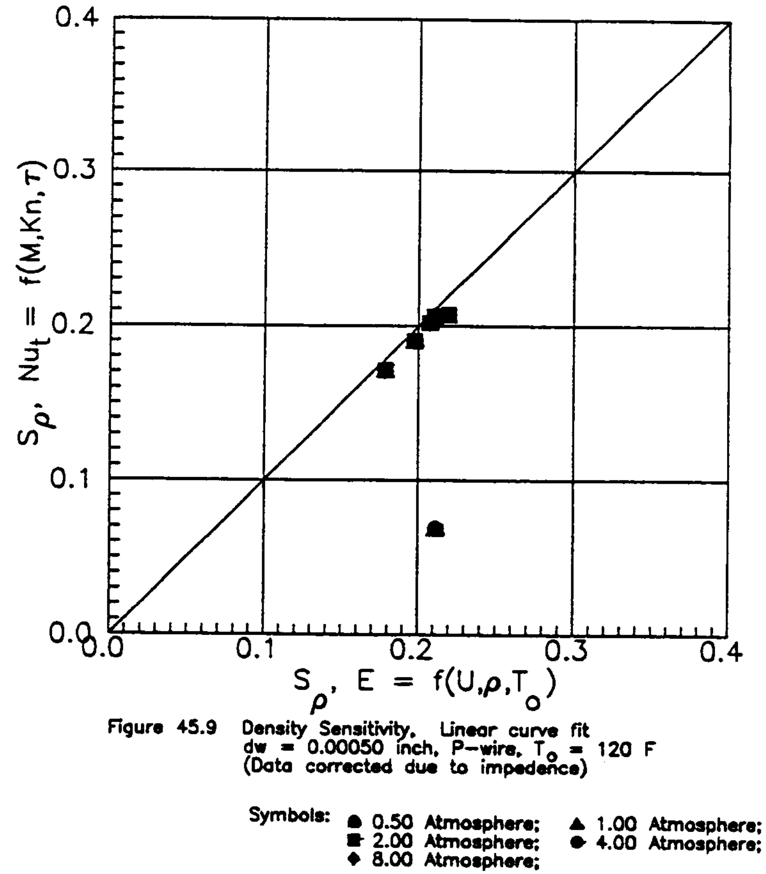

Figure 45.9 Density Sensitivity, Linear curve fit
$dw = 0.00050$ inch, P–wire, $T_o = 120$ F
(Data corrected due to impedence)

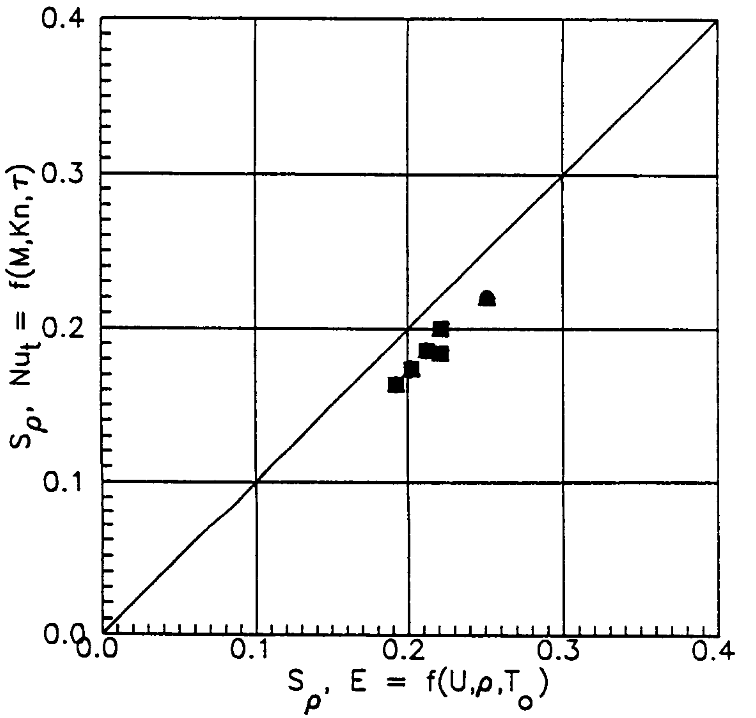

Figure 46.1 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, Y-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

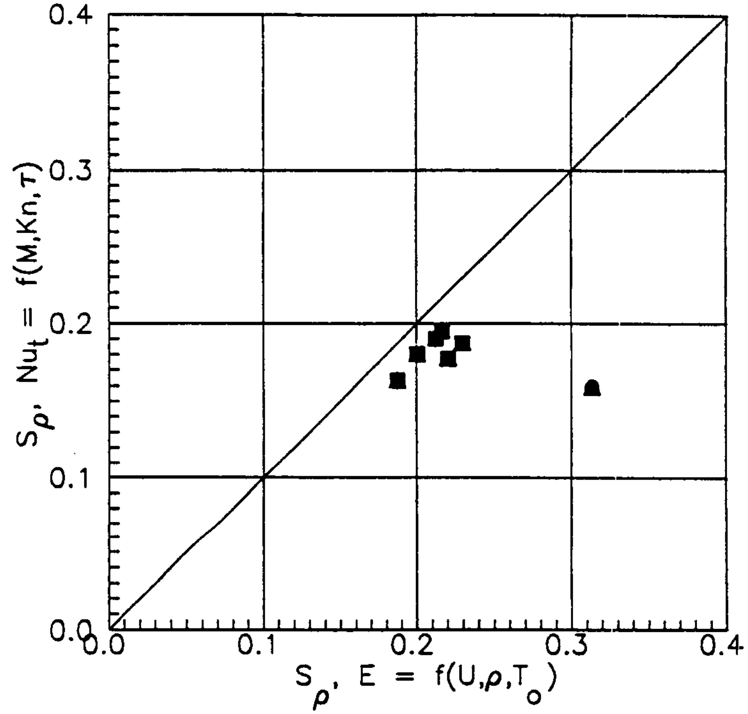

Figure 46.2 Density Sensitivity, Linear curve fit
dw = 0.00032 inch, Y-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

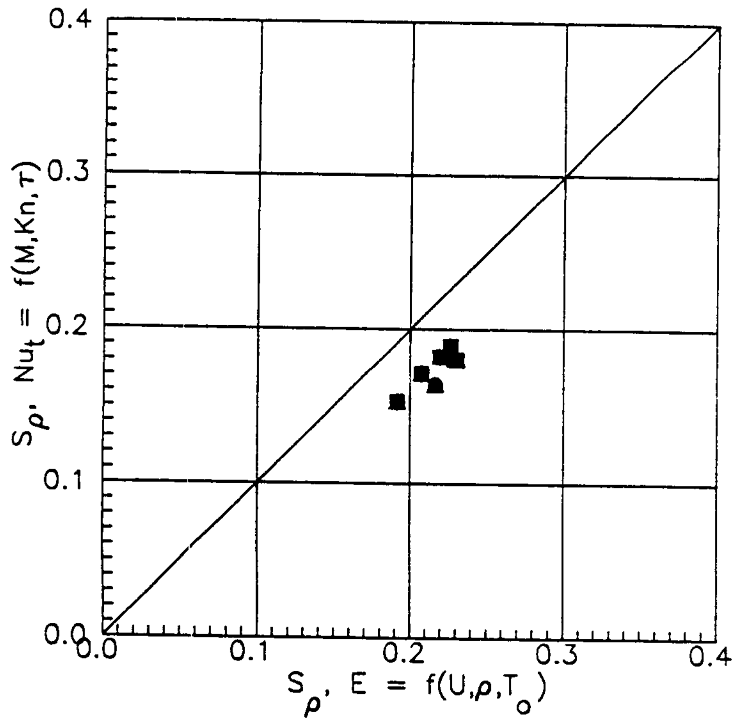

Figure 46.3 Density Sensitivity, Linear curve fit
dw = 0.00050 inch, Y-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

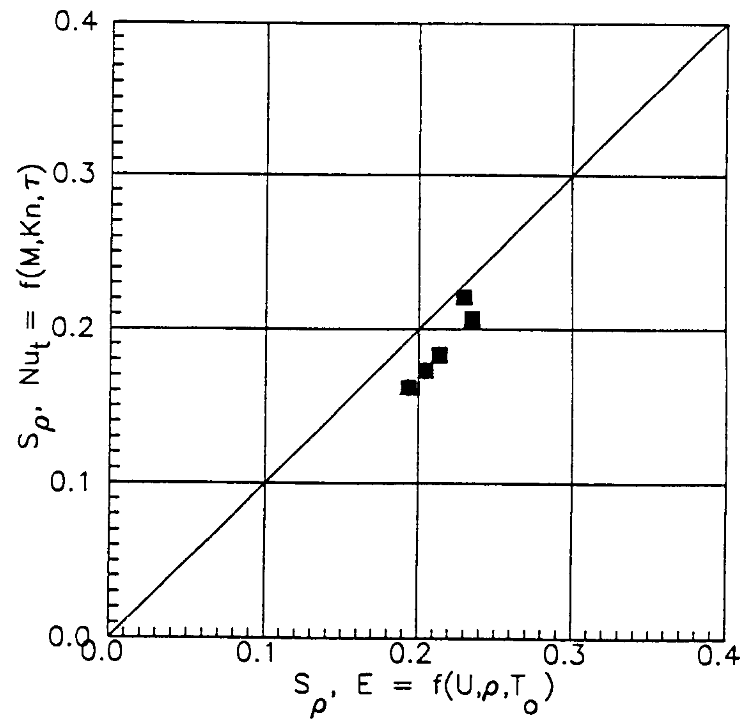

Figure 46.4 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, Y-wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

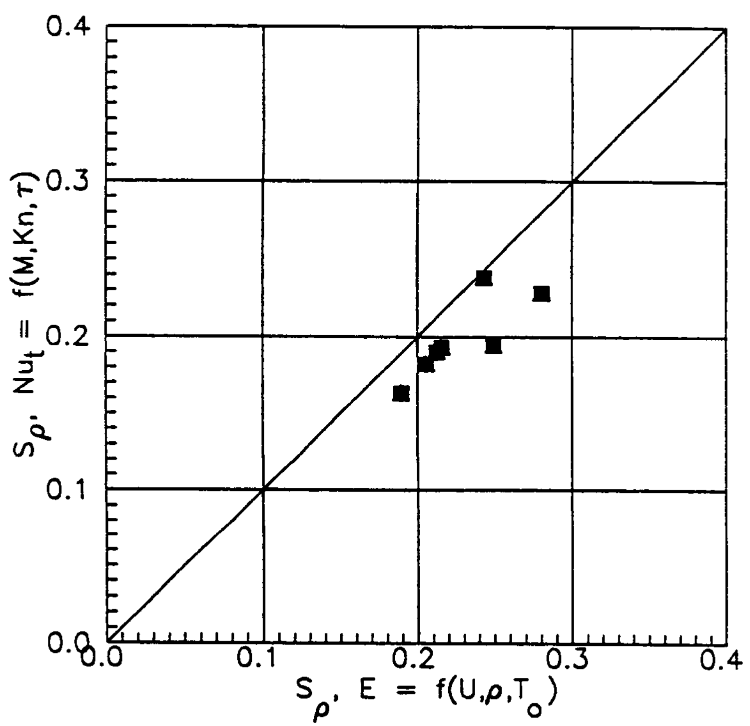

Figure 46.5 Density Sensitivity, Linear curve fit
dw = 0.00032 inch, Y–wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

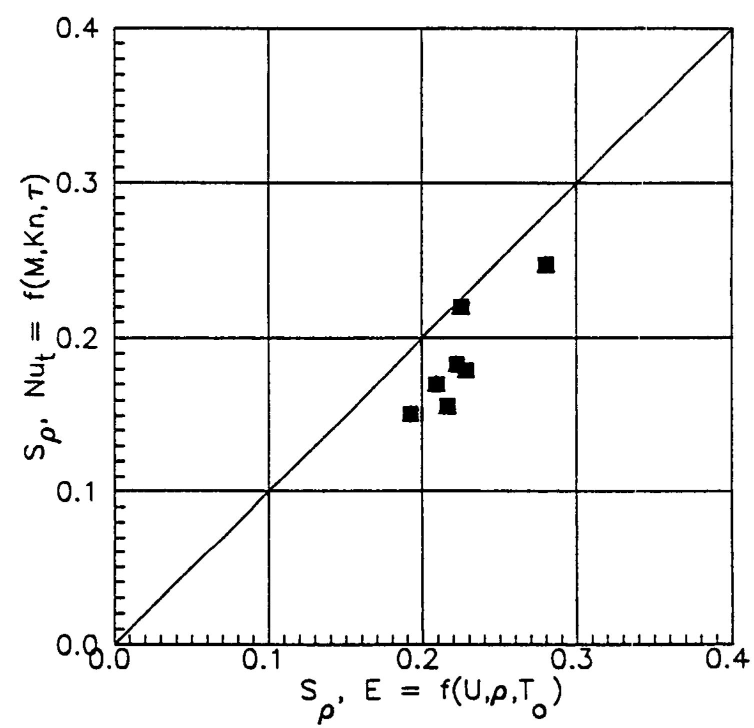

Figure 46.6 Density Sensitivity, Linear curve fit
dw = 0.00050 inch, Y–wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

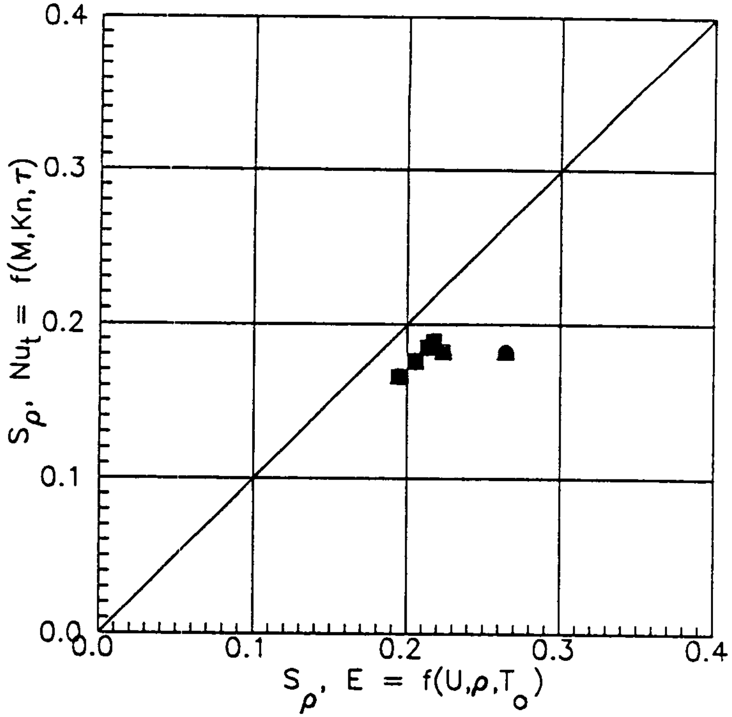

Figure 46.7 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, Y-wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

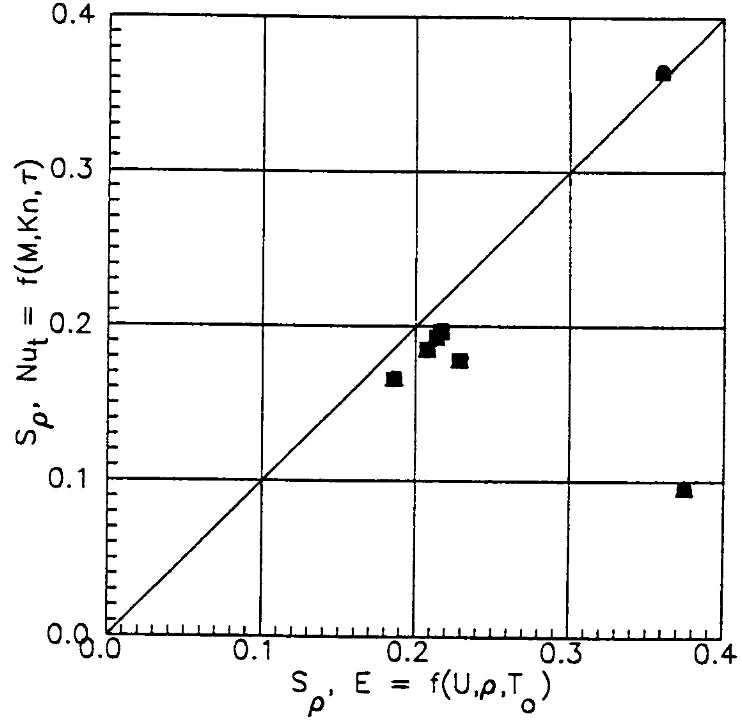

Figure 46.8 Density Sensitivity, Linear curve fit
dw = 0.00032 inch, Y-wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

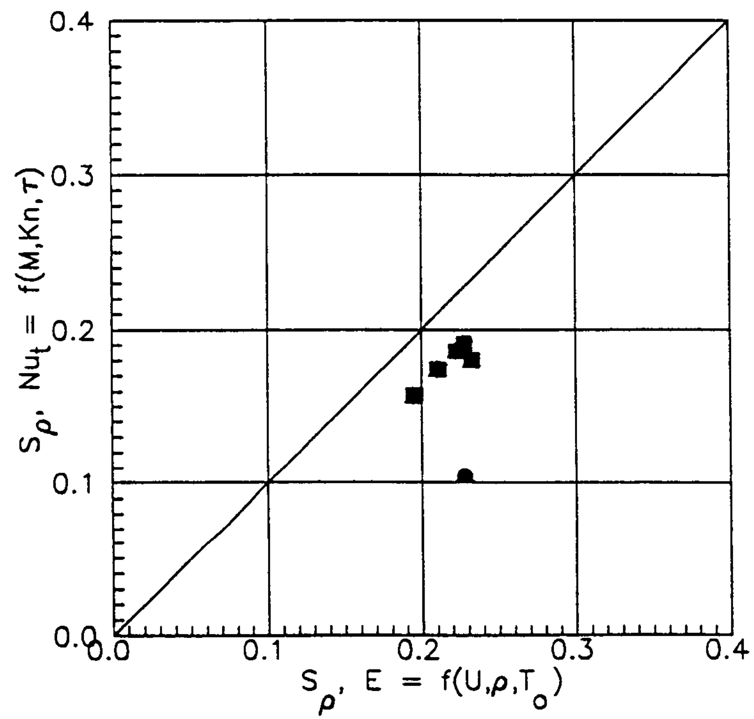

Figure 46.9 Density Sensitivity, Linear curve fit
dw = 0.00050 inch, Y–wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

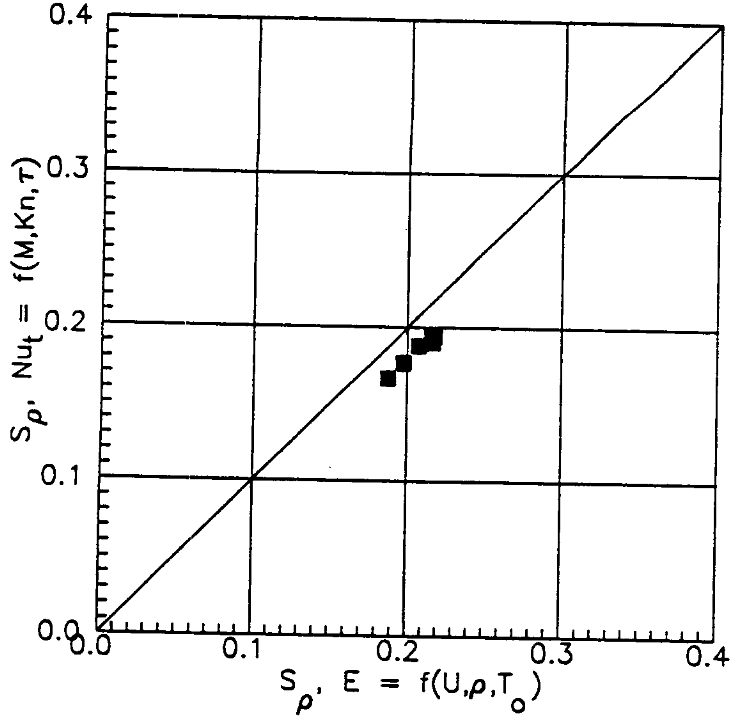

Figure 47.1 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, S-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

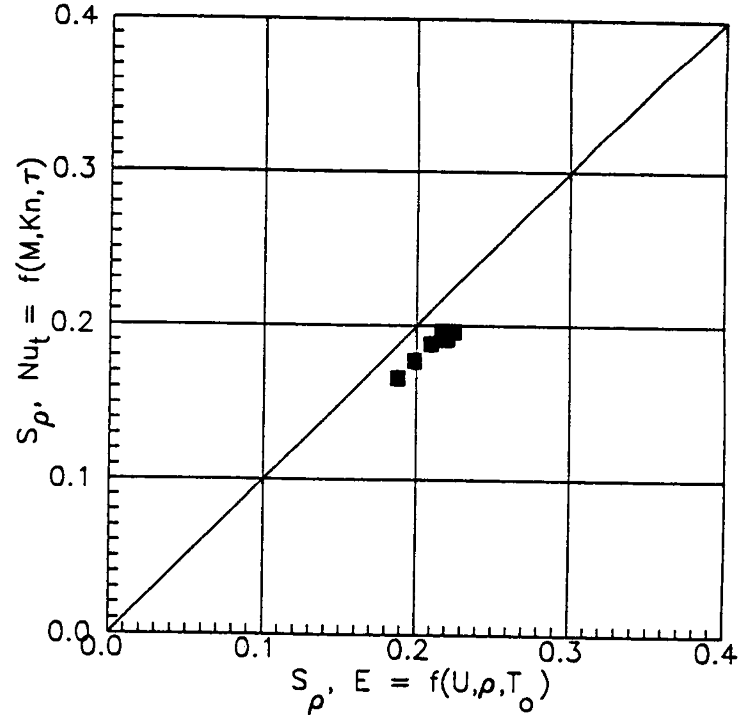

Figure 47.2 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, S-wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

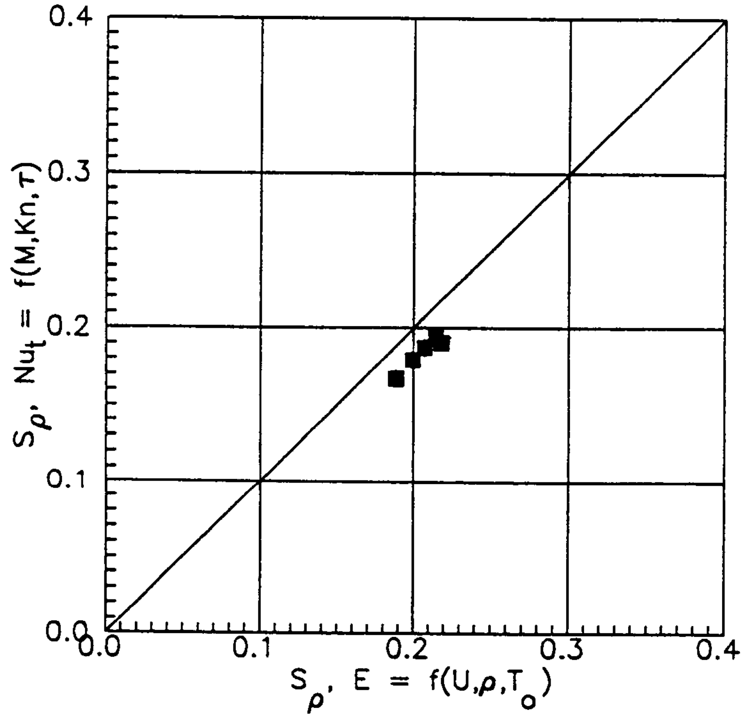

Figure 47.3 Density Sensitivity, Linear curve fit
dw = 0.00015 inch, S–wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ♦ 8.00 Atmosphere;

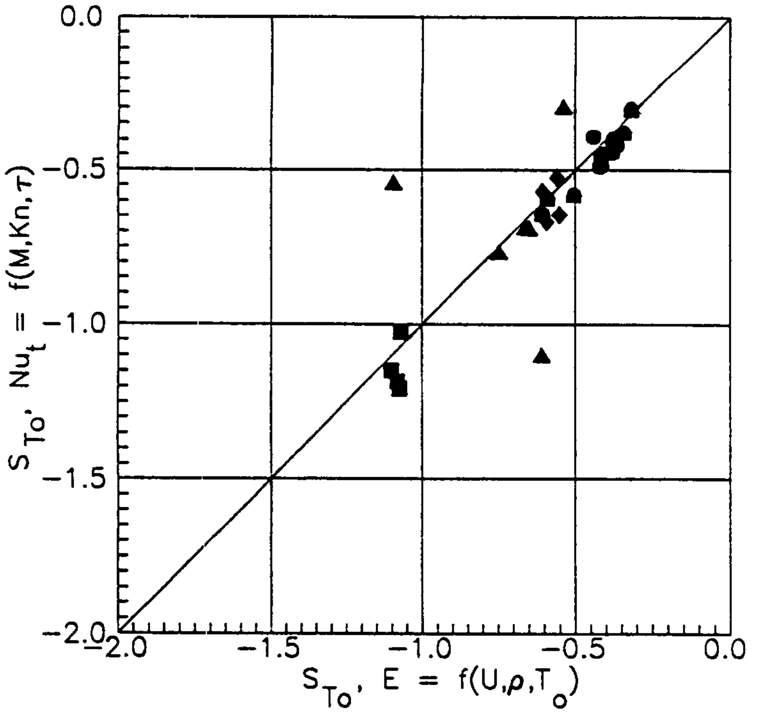

Figure 48.1 Temperature Sensitivity, Linear curve fit
Dw = 0.00015 inch, P-wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

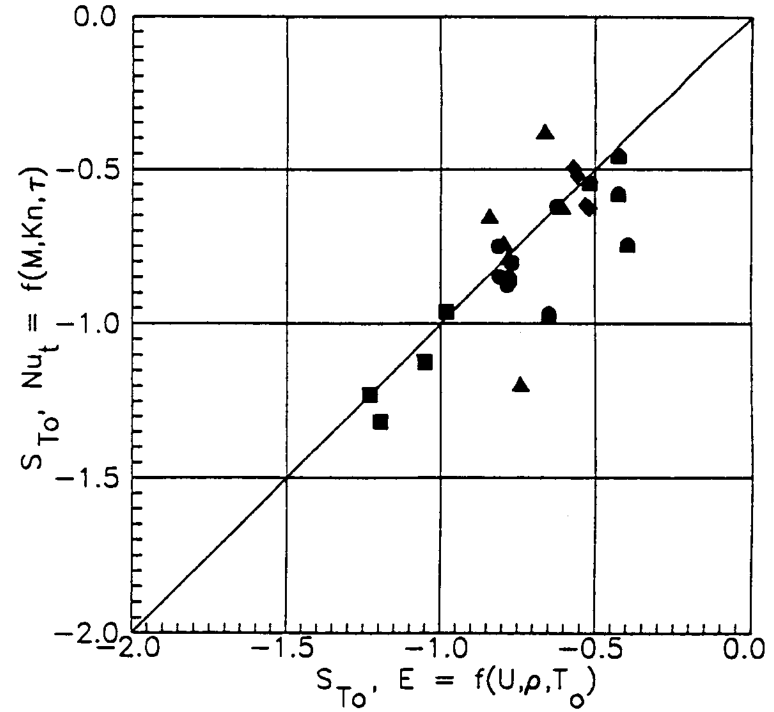

Figure 48.2 Temperature Sensitivity, Linear curve fit
dw = 0.00032 inch, P-wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

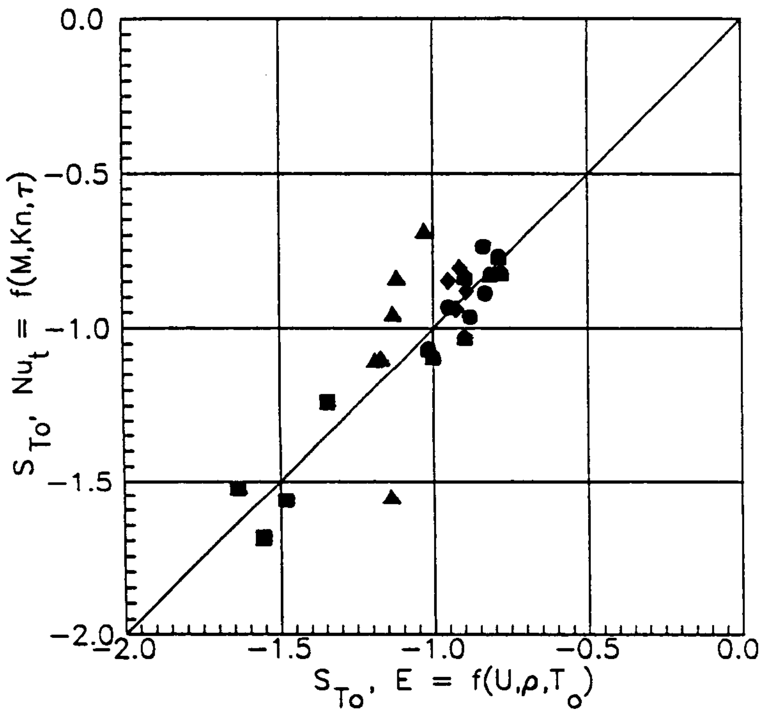

Figure 48.3 Temperature Sensitivity, Linear curve fit
dw = 0.00050 inch, P–wire, T_o = 80 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

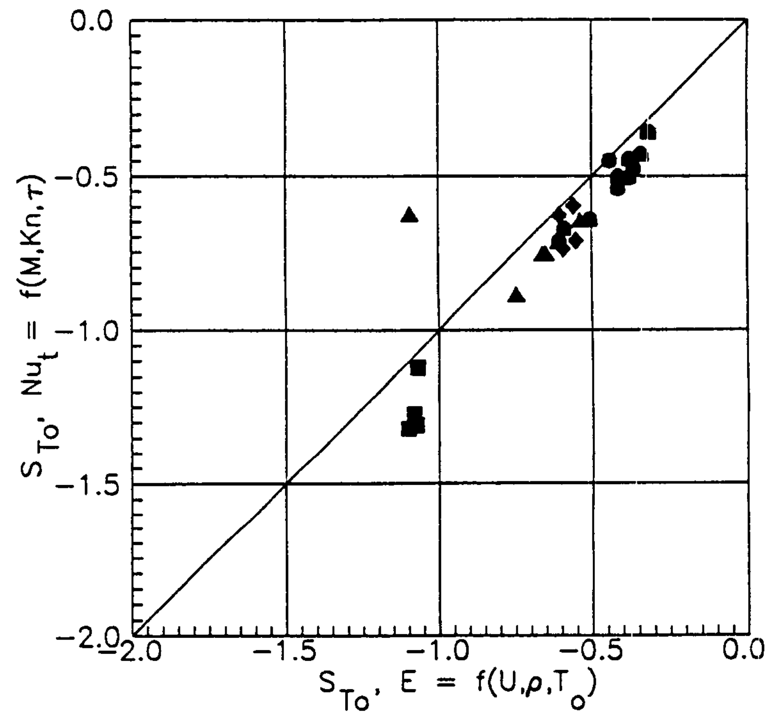

Figure 48.4 Temperature Sensitivity, Linear curve fit
dw = 0.00015 inch, P–wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

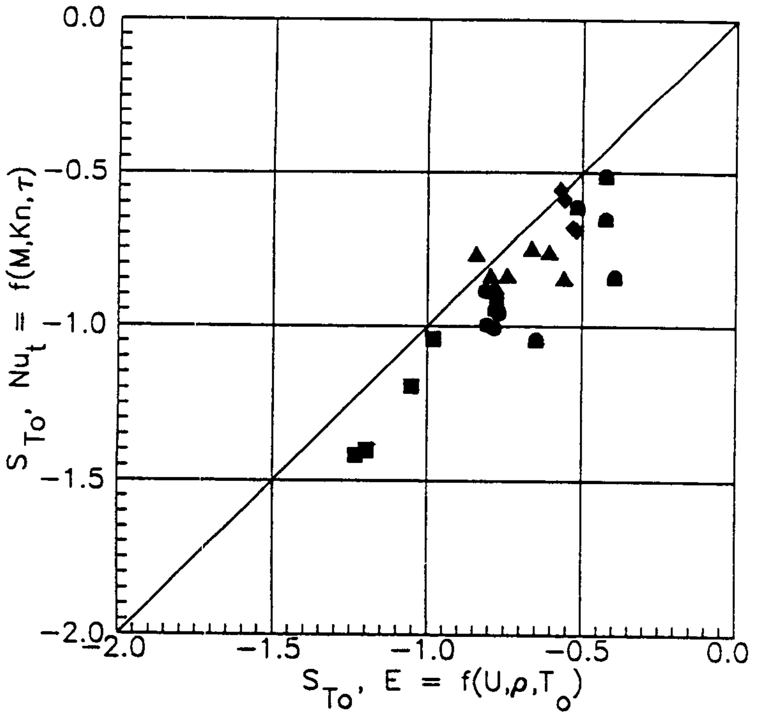

Figure 48.5 Temperature Sensitivity, Linear curve fit
dw = 0.00032 inch, P–wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

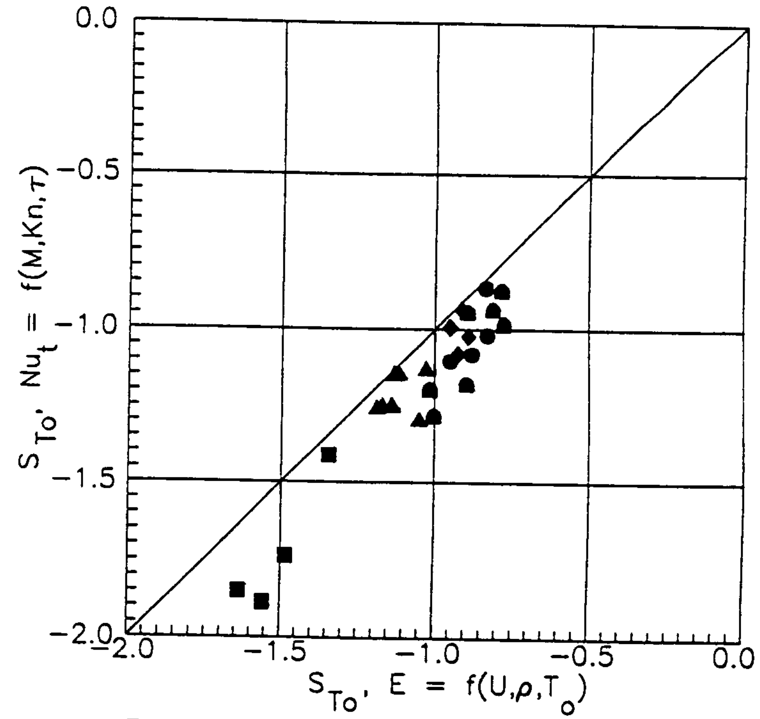

Figure 48.6 Temperature Sensitivity, Linear curve fit
dw = 0.00050 inch, P–wire, T_o = 100 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

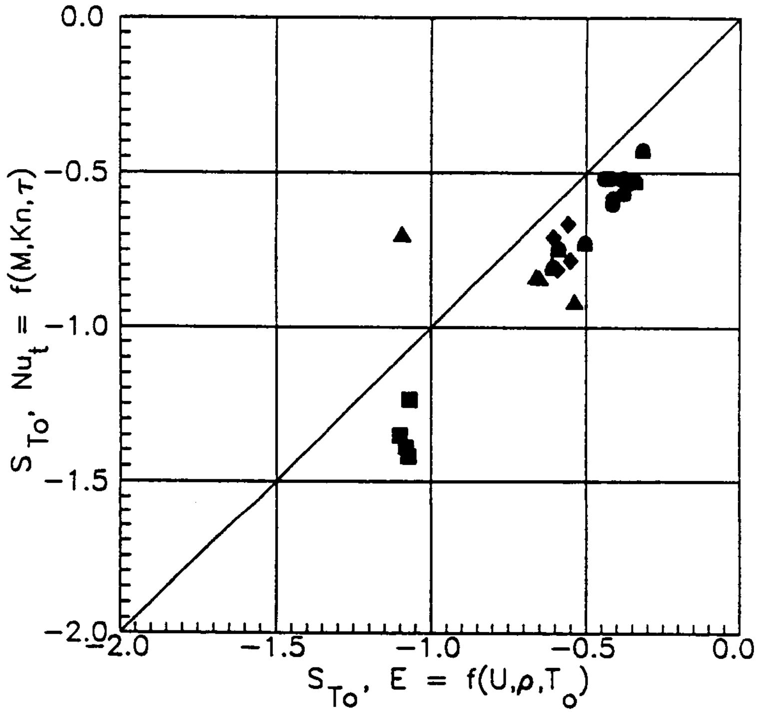

Figure 48.7 Temperature Sensitivity, Linear curve fit
dw = 0.00015 inch, P–wire, T_o = 120 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ■ 2.00 Atmosphere; ◆ 8.00 Atmosphere; ▲ 1.00 Atmosphere; ● 4.00 Atmosphere;

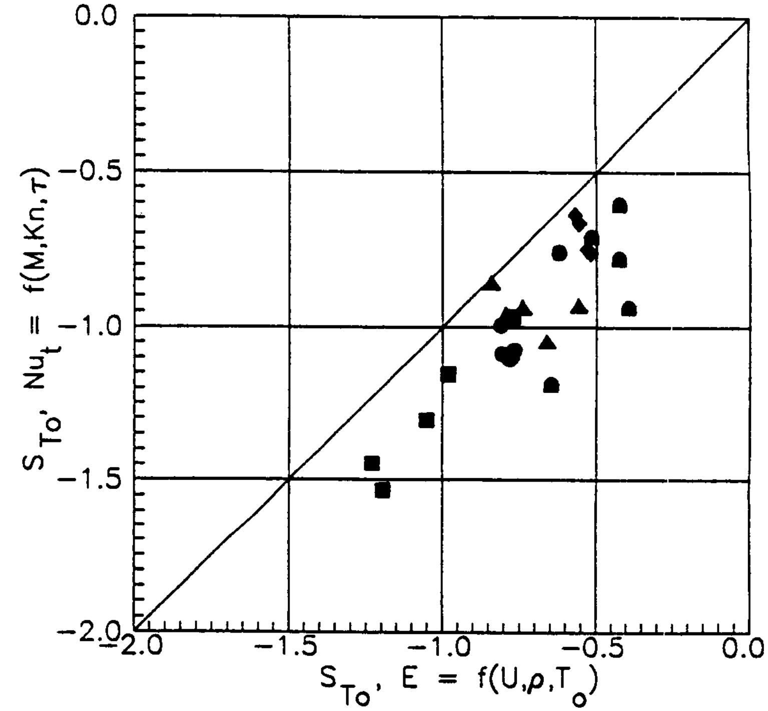

Figure 48.8 Temperature Sensitivity, Linear curve fit
dw = 0.00032 inch, P–wire, T_o = 120 F
(Data corrected due to impedence)

Symbols: ● 0.50 Atmosphere; ■ 2.00 Atmosphere; ◆ 8.00 Atmosphere; ▲ 1.00 Atmosphere; ● 4.00 Atmosphere;

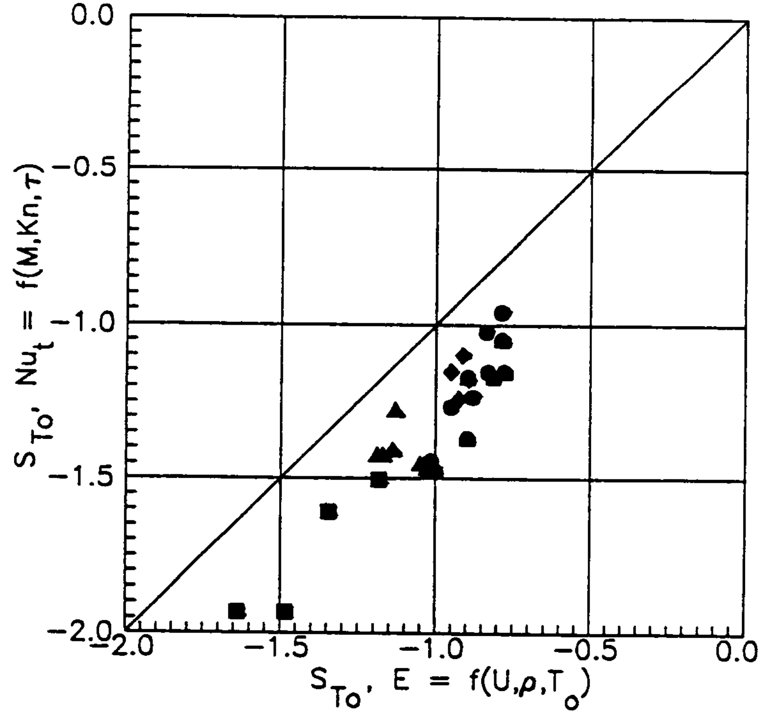

Figure 48.9 Temperature Sensitivity, Linear curve fit
dw = 0.00050 inch, P-wire, T_o = 120 F
(Data corrected due to impedence)

Symbols: 0.50 Atmosphere; 1.00 Atmosphere;
2.00 Atmosphere; 4.00 Atmosphere;
8.00 Atmosphere;

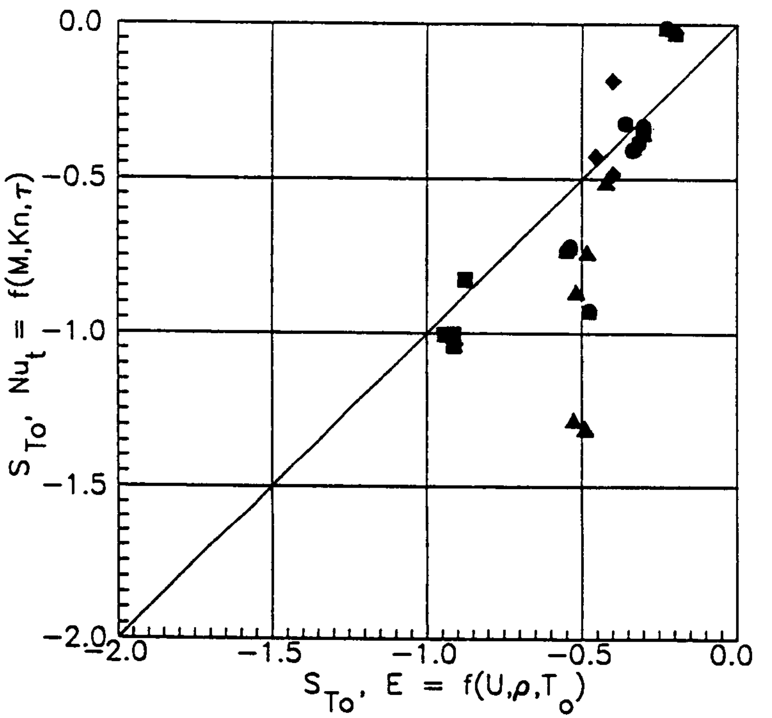

Figure 49.1 Temperature Sensitivity, Linear curve fit
dw = 0.00015 inch, Y-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

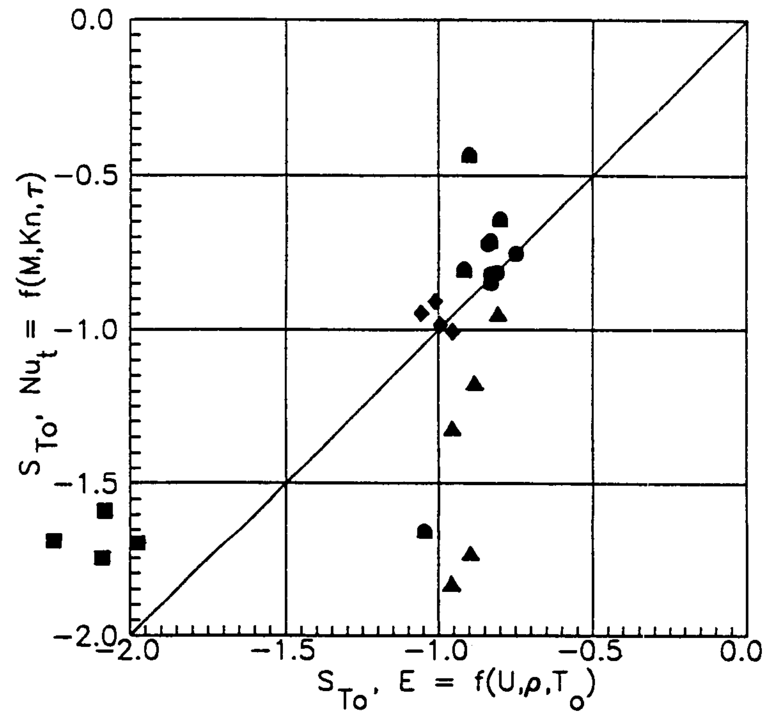

Figure 49.2 Temperature Sensitivity, Linear curve fit
dw = 0.00032 inch, Y-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

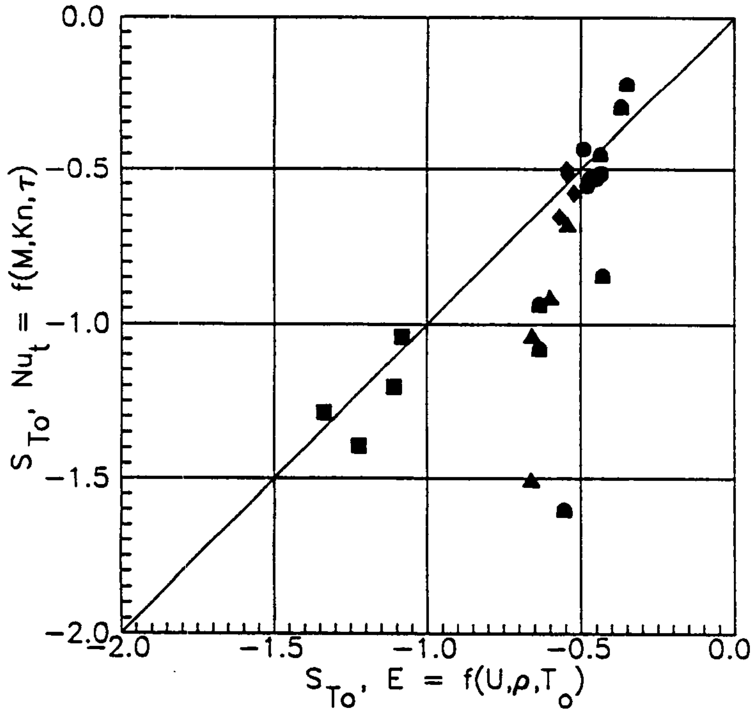

Figure 49.3 Temperature Sensitivity, Linear curve fit
dw = 0.00050 inch, Y–wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

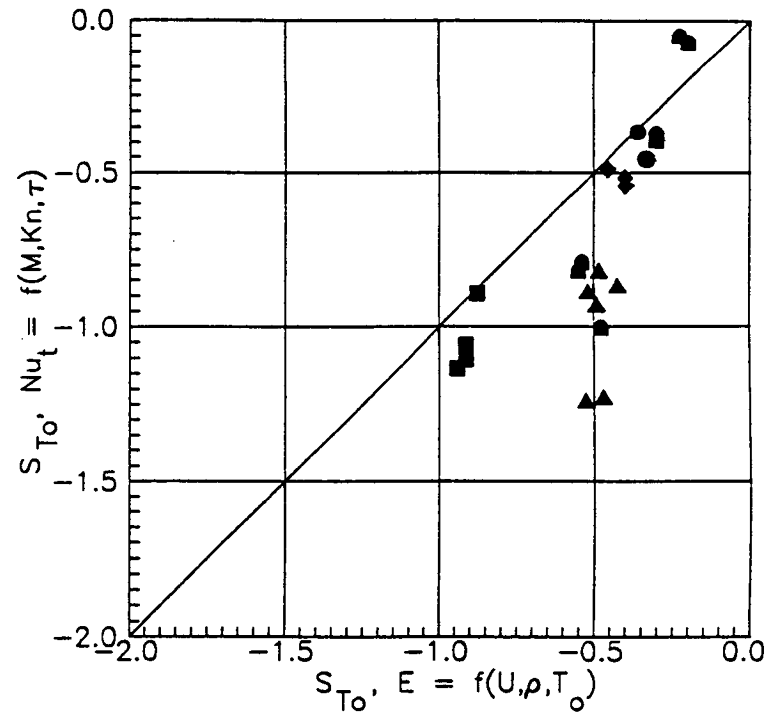

Figure 49.4 Temperature Sensitivity, Linear curve fit
dw = 0.00015 inch, Y–wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

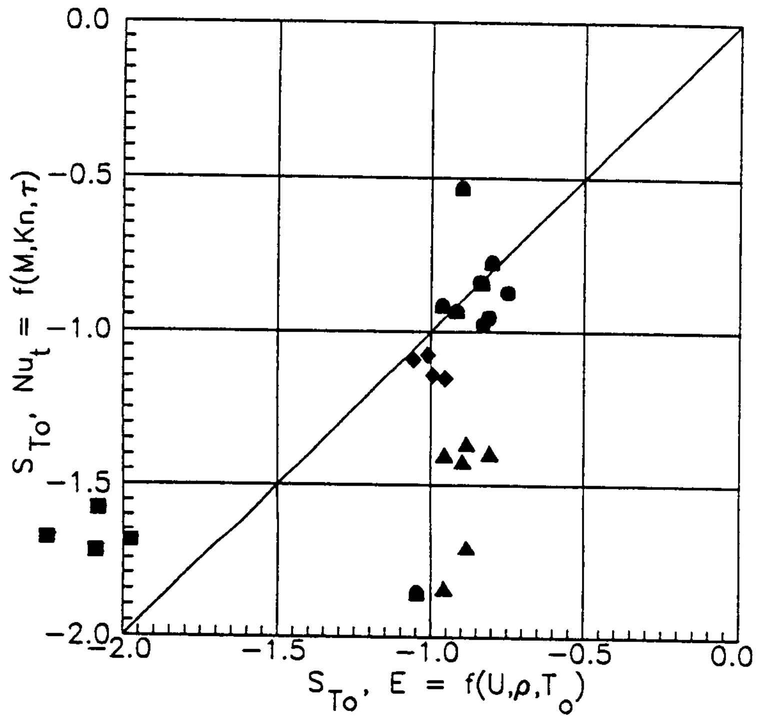

Figure 49.5 Temperature Sensitivity, Linear curve fit
dw = 0.00032 inch, Y–wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

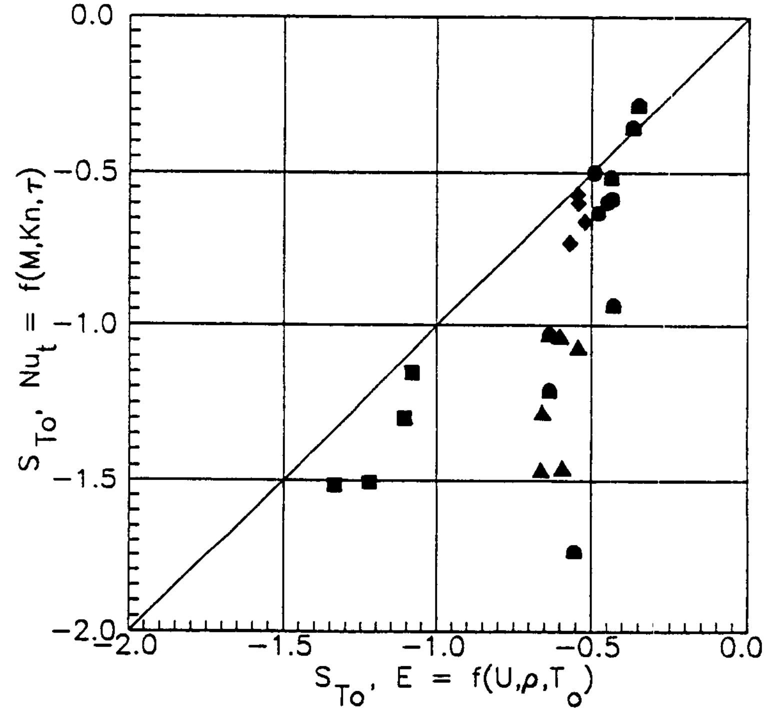

Figure 49.6 Temperature Sensitivity, Linear curve fit
dw = 0.00050 inch, Y–wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

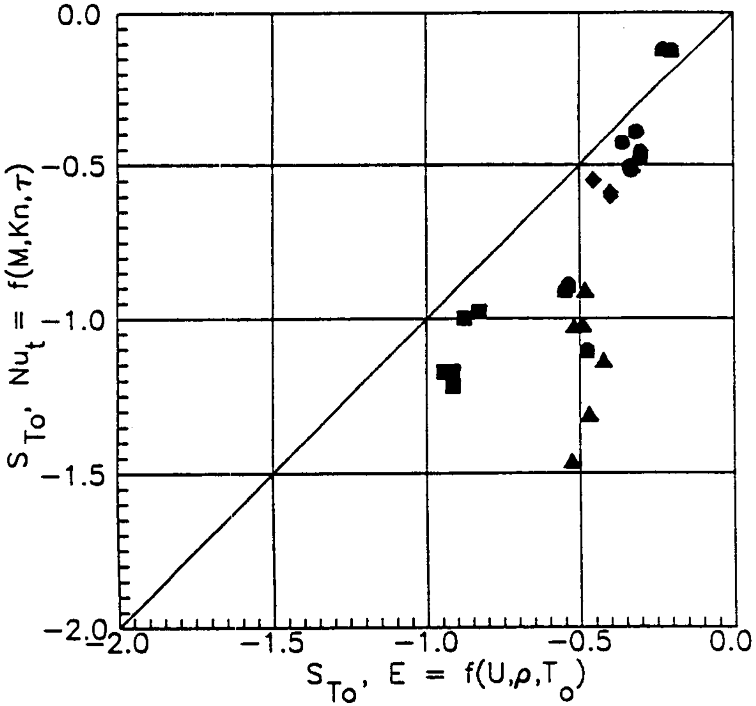

Figure 49.7 Temperature Sensitivity, Linear curve fit
dw = 0.00015 inch, Y-wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

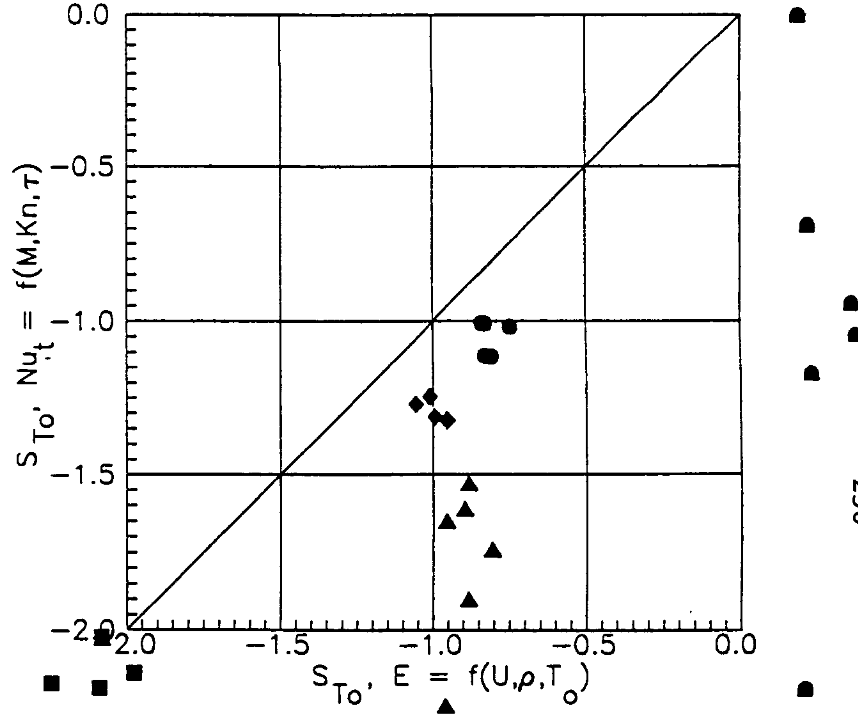

Figure 49.8 Temperature Sensitivity, Linear curve fit
dw = 0.00032 inch, Y-wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

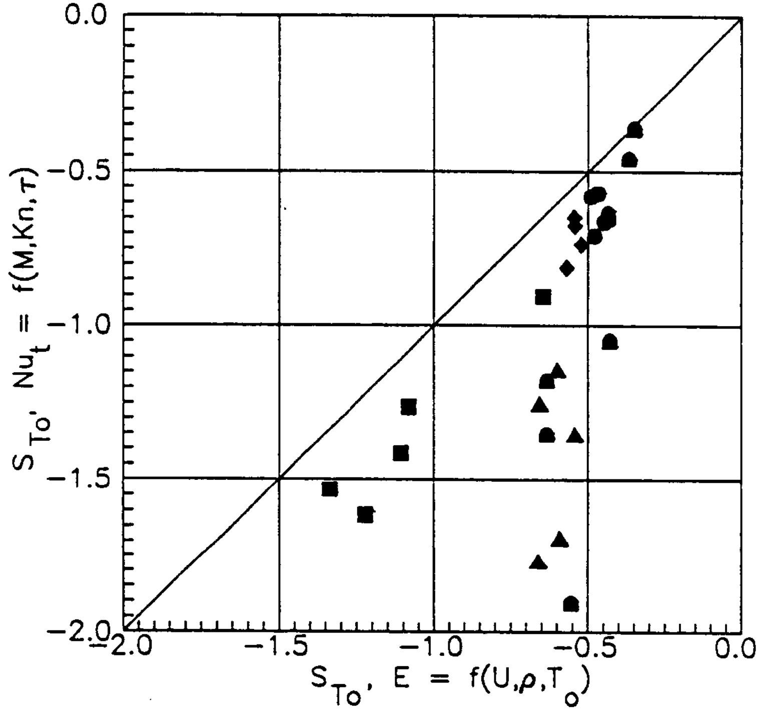

Figure 49.9 Temperature Sensitivity, Linear curve fit
dw = 0.00050 inch, Y–wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

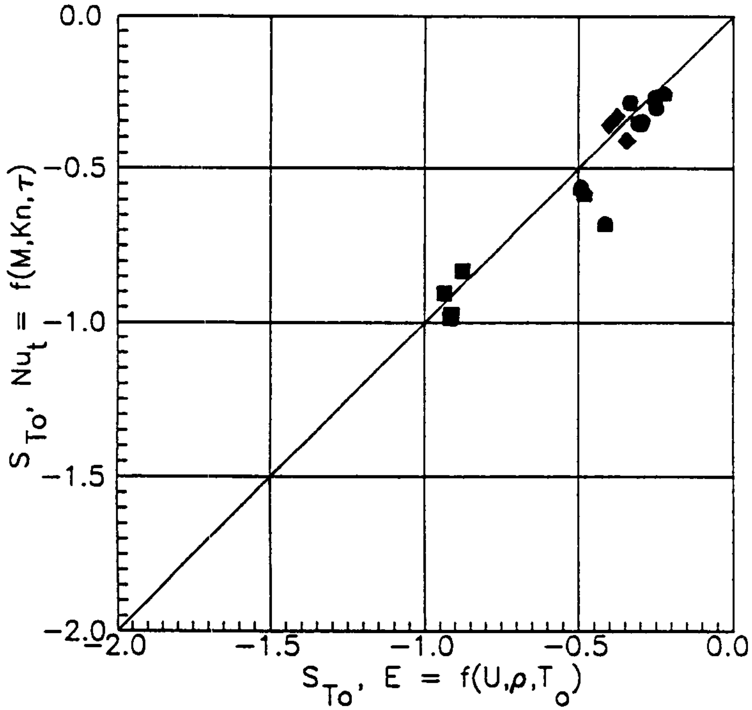

Figure 50.1 Temperature Sensitivity, Linear curve fit
dw = 0.00015 inch, S-wire, T_o = 80 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

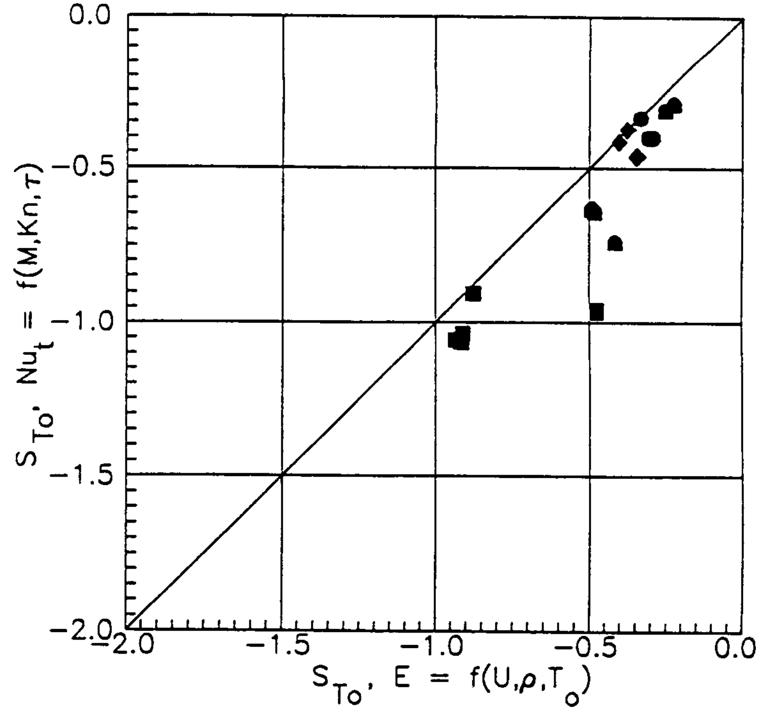

Figure 50.2 Temperature Sensitivity, Linear curve fit
dw = 0.00015 inch, S-wire, T_o = 100 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere; ■ 2.00 Atmosphere; ● 4.00 Atmosphere; ◆ 8.00 Atmosphere;

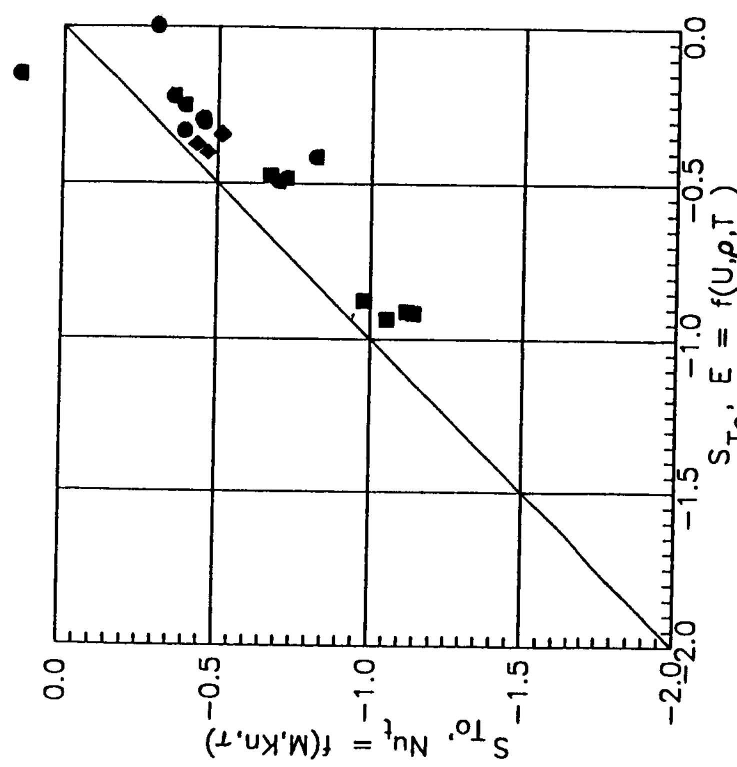

Figure 50.3 Temperature Sensitivity, Linear curve fit
dw = 0.00015 inch, S-wire, T_o = 120 F

Symbols: ● 0.50 Atmosphere; ▲ 1.00 Atmosphere;
■ 2.00 Atmosphere; ● 4.00 Atmosphere;
◆ 8.00 Atmosphere;

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13. ABSTRACT *(Maximum 200 words)*

The heat transfer from heated wires were measured using a constant temperature anemometer over a Mach number range from 0.05 to 0.4 and pressures from 0.5 to 8.0 atmosphere. The total temperature ranged from 80°F to 120°F and the wire diameters were 0.00015, 0.00032 and 0.00050 inch. The heat transfer data is presented in the form of corrected Nusselt number. Based on the criteria suggested by Baldwin (1958), much of the data was obtained in the slip flow regime. Therefore, the data is compared with his data having comparable flow conditions.

The possible application of the heat transfer data to hot wire anemometry is discussed. To this end, the sensitivity of the wires to velocity, density and total temperature is computed and compared using two different types of correlations.

14. SUBJECT TERMS
Hot Wire; Constant Temperature Anemometry; Fluctuating; Slip Flow; Three-Wire Measurement; Heat Transfer; Sensitivity; Calibration

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